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JUNE, 1906.

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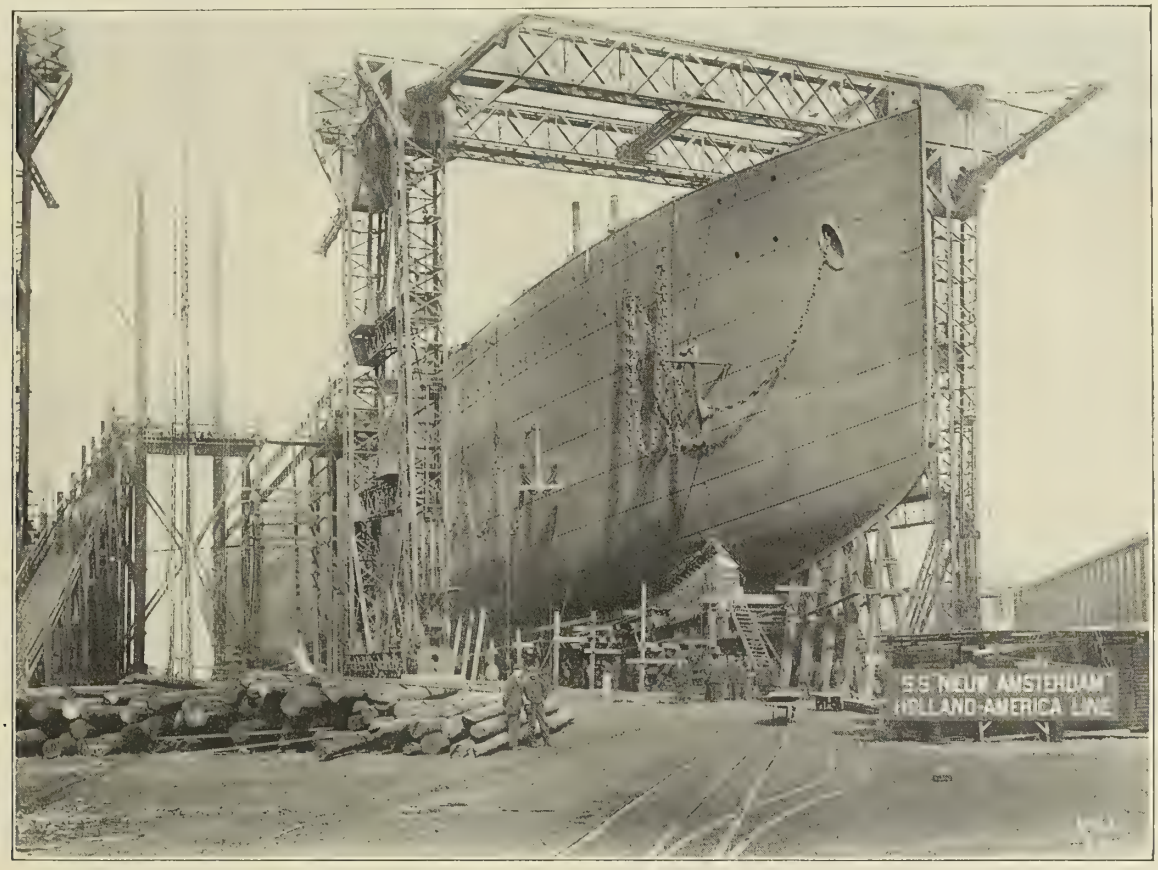
THE HOLLAND-AMERICA LINER NIEUW AMSTERDAM.

This latest production of the Harland & Wolff shipyard, Belfast, which was launched September 28, 1905, reached New York on the afternoon of Monday, April 16, after a voyage which began at noon, April 7, at Rotterdam. The time of passage from pier to pier was about nine days and nine hours. The daily runs on this her first voyage ranged from a maximum of 395 nautical miles to a minimum of 314. The larger distance was covered at a mean rate of 16.45 knots continued through twenty-four hours, while the voyage for the entire trip was a little better than 15 knots, which is a very creditable performance.

Five decks have been set apart for the accommodation of passengers, the principal apartments being located centrally and far above the water. The decorative treatment of the interior is decidedly novel and very attractive. In most instances the style used is Dutch from various periods, with panels giving views both in Holland, and in New Amsterdam as it existed during the time of the Dutch governors, the wood work being invariably light in color, thus lending an air of lightness and grace to the entire scheme of decoration, in place of the dark and heavy effects so common in steamship work.



BOW VIEW OF THE NIEUW AMSTERDAM, BEFORE LAUNCHING.

The *Nieuw Amsterdam* has a length between perpendiculars of 600 feet, a length over all of 615 feet; a beam of 68 feet 6 inches; and a depth of 48 feet. The gross registered tonnage is 16,913, with a net tonnage of 10,687, and a displacement at load draft (35 feet) of 31,150 tons. The dead weight carrying capacity is about 12,000 tons. The ship is rigged as a four-masted schooner. Accommodation is provided for 440 first-class, 246 second-class and 2,200 third-class passengers; besides the crew of 305 men, including 50 in the navigating department, 90 in the engineering department, and 165 in the stewards' department. On the maiden voyage the complement of passengers included 306 in the cabin and 1,982 in the steerage.

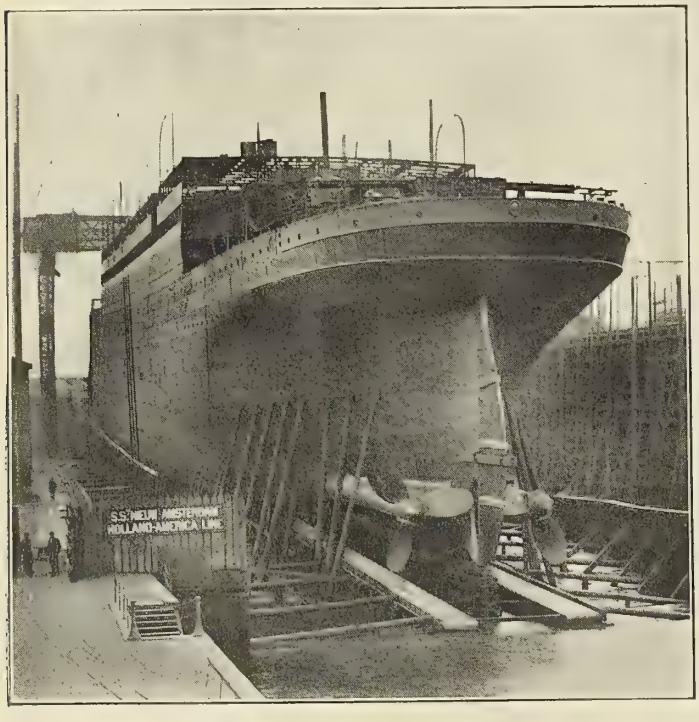
The first-class dining saloon is decorated with Austrian oak framing with stamped metal panels, there being overhead a pleasing dome with art plaques representing the seasons, and with medallions carrying relief representations of state and municipal arms. Among the latter might be mentioned the arms of Holland, of the state of New York, and of the cities of New York, Amsterdam and Rotterdam.

The social hall and music room is situated on the promenade deck and is finished in polished mahogany enriched with gilt bronze empire ornaments. The fireplace at the forward end is constructed of turquoise blue marble and cream colored tilings, a wood fire being represented by means of electric apparatus hidden

behind asbestos logs. The same sort of fireplace is situated in the after end of the first-class smoking room. Above the mantel of the fireplace in the social hall is a large tiled picture illustrating the city of New Amsterdam as it appeared early in the eighteenth century. In this apartment are hung autograph paintings of Queen Wilhelmina and the Prince Consort. In the equipment are included an organ and a Steinway grand piano. The entrance from the promenade deck is finished in teak and birdseye maple, surmounted by an ornamental glass dome.

NIEUW AMSTERDAM AFLOAT, SEPTEMBER 28, 1905.

One of the most prominent novelties on the ship is the Japanese tea room, located in the center of the promenade deck, and connecting, by means of a short passage, with the smoking room.



STERN VIEW JUST BEFORE LAUNCHING.

The decoration consists of Japanese art panels in polished satinwood, with black inlaid lacquer work, while the ceiling is decorated with paintings on linen. During the day, light is admitted through a dome of tinted and painted glass, while at night illumination is supplied by suspended Japanese lamps fitted with electric lights. The fireplace is of black lacquered marble with painted tilings; the floor is covered with rubber tilings. Tables and chairs are Japanese in style.

The first-class smoking room, which is aft of the tea room, is a broad apartment with a thoroughly Dutch decorative scheme finished in fumed oak, with Palissander wood inlays, and tiles from the famous Dutch art potteries. A Belgian marble mantelpiece at one end is decorated with old Dutch tiles, the furnishings throughout the apartment being Dutch in every respect.

The first cabin staterooms are situated on the upper, the saloon and the bridge decks. They are very spacious and are fitted to accommodate two or three passengers. In many cases the disadvantage of having an inside room is done away with by the fitting of tandem staterooms. The staterooms on the bridge deck are especially large, and include a number of suites or cabins de luxe which are fitted in many cases with brass bedsteads in place of the customary steamer berths.

The second cabin staterooms are located on the upper deck, aft of the first cabin accommodation, and are finished in similar style, though less elaborately. The second-class dining saloon, which is on the saloon deck aft, extends the full width of the ship and has a dome ornamented with colored glass. Above this dining saloon are the second cabin ladies' room, and the smoking room, both of which are finished in light colored hard woods with inlaid decorations.

One of the notable features of the ship, and one which will commend itself to passengers, is the breadth and extent of promenade space on the promenade deck. An unusual amount of such space has been provided, there being no less than 8,200 square feet on this deck, 4,440 square feet on the bridge deck and 5,000 square feet on the boat deck. The promenade facilities provided for second cabin passengers are also ample.

The hull construction is, of course, entirely of steel, with a double bottom extending the full length of the ship. The hull is divided by twelve transverse bulkheads reaching to the upper deck into thirteen watertight compartments, this including the watertight bulkhead separating the two sets of boilers.

SCANTLINGS.

The frame spacing throughout is 30½ inches. For the greater part of the length of the ship the frames are channels measuring 9 by 4 by 4 by 13-20 inches, while forward and aft angle bars are used, 9 by 4 by 12-20 inches, with reverse frames 4 by 4 by 12-20 inches. The deck beams up to and including the saloon deck are channels 10 by 4 by 4 by 11-20 inches, while above this are fitted

bulb angles measuring 7½ by 3½ by 10-20 inches. The floor plates, which extend in each case from margin plate to margin plate, measure 12-20 and 11-20 inches respectively amidships and at ends. They are fastened to the bottom plating by angles 4 by 4 by 12-20 inches amidships, and 4 by 4 by 11-20 inches at the ends.

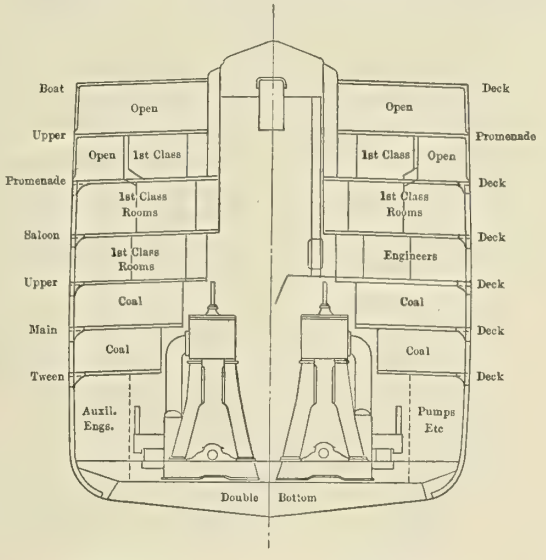
THE STEAMSHIP NIEUW AMSTERDAM AT SEA.

A flat keel plate is fitted, 23-20 inch thick, with a flat rubbing piece outside, measuring 12 by 3 inches. The garboard strake is 20-20 inches amidships, while the next five bottom strakes measure each 18-20. The four bilge strakes measure 19-20 inch, while the two strakes at the sharpest part of the turn of the bilge have liners of the same thickness. The six strakes next above the bilges measure 19-20 inch in outside courses and 18-20 inch in inside courses. Above this, the inner and outer courses are respectively 19-20 and 20-20 inch, while the sheer strake, 1 inch thick, is backed up by a liner of the same thickness. The sheer strake proper is 59 inches wide, its doubling or liner strake having the same width. The strake immediately below is 37 inches wide, while the liner, of 19-20-inch plate, is 50½ inches wide. In each case the lap measures 6¾ inches. The side plating above the saloon deck is 12-20 inch thick.

The center line vertical keelson measures 56 inches wide and 16-20 inch thick. Fore-and-aft plates forming margins of the double bottom are 15-20 inch thick amidships and 13-20 at ends. The tank top consists of plates 12-20 inch thick in general, with thickness increased to 13-20 inch in engine and boiler rooms. Side stringers above the turn of bilge consist of 15-20-inch plates amidships, each fitted with a continuous angle bar running along channel framing and measuring 6½ by 4½ by 12-20 inches amidships and 11-20 inch thick forward and aft; a continuous angle bar turned down over the inboard edge, 6½ by 4½ by 15-20 inches amidships and 14-20 inch forward and aft; and intercostal angles connecting with side plating. Fore-and-aft channels are fitted at about the quarter width under the deck beams of platforms, 'tween decks, main, upper and saloon deck, being in all cases 7 by 3½ by 3½ by 10-20 inches.

Additional fore-and-aft longitudinal stiffness is assured by 15-20 inch stringer plates on platforms and 'tween decks, with 14-20 inch plates in the next strake and the balance of the steel decks in each case 7-20 inch thick. The main deck and upper deck have stringer plates 18-20 inch thick, with the next strakes 17-20 and 18-20 inch respectively, and with complete steel decks 10-20 and 12-20 inch thick respectively. The saloon deck has a stringer plate 19-20 inch thick, the next two strakes being 18-20 and the balance of the steel deck 13-20 inch. The promenade deck, which does not contribute very heavily to the longitudinal strength, has a stringer plate 10-20 inch, the balance of the complete steel deck being 6-20 inch thick.

From the double bottom to the upper deck, throughout the central portion of the ship, is a bulkhead of $\frac{5}{16}$-inch plating, with vertical stiffeners acting also as stanchions at the center line. These stanchions, up to the 'tween deck, are channels measuring



TRANSVERSE SECTION, SHOWING ACCOMMODATIONS.

8 by 3½ by 3½ by 11-20 inches; with 4 by 3 by $\frac{7}{16}$-inch angles on the back. From 'tween deck to main deck the channels measure 7 by 3½ by 3½ by 10-20 inches, while above the main deck are fitted 6 by 3 by 10-20-inch bulb angles. In each of these latter cases, moreover, additional stiffening is provided by 3½ by 2½ by ⅜-inch angles. Above the upper deck are stanchions

3½ inches in diameter and spaced 5 feet 1 inch apart. The quarter stanchions below the platforms are 5 inches in diameter; between platforms and 'tween deck, 4⅝ inches; from 'tween deck

THE MUSIC ROOM AND SOCIAL HALL.

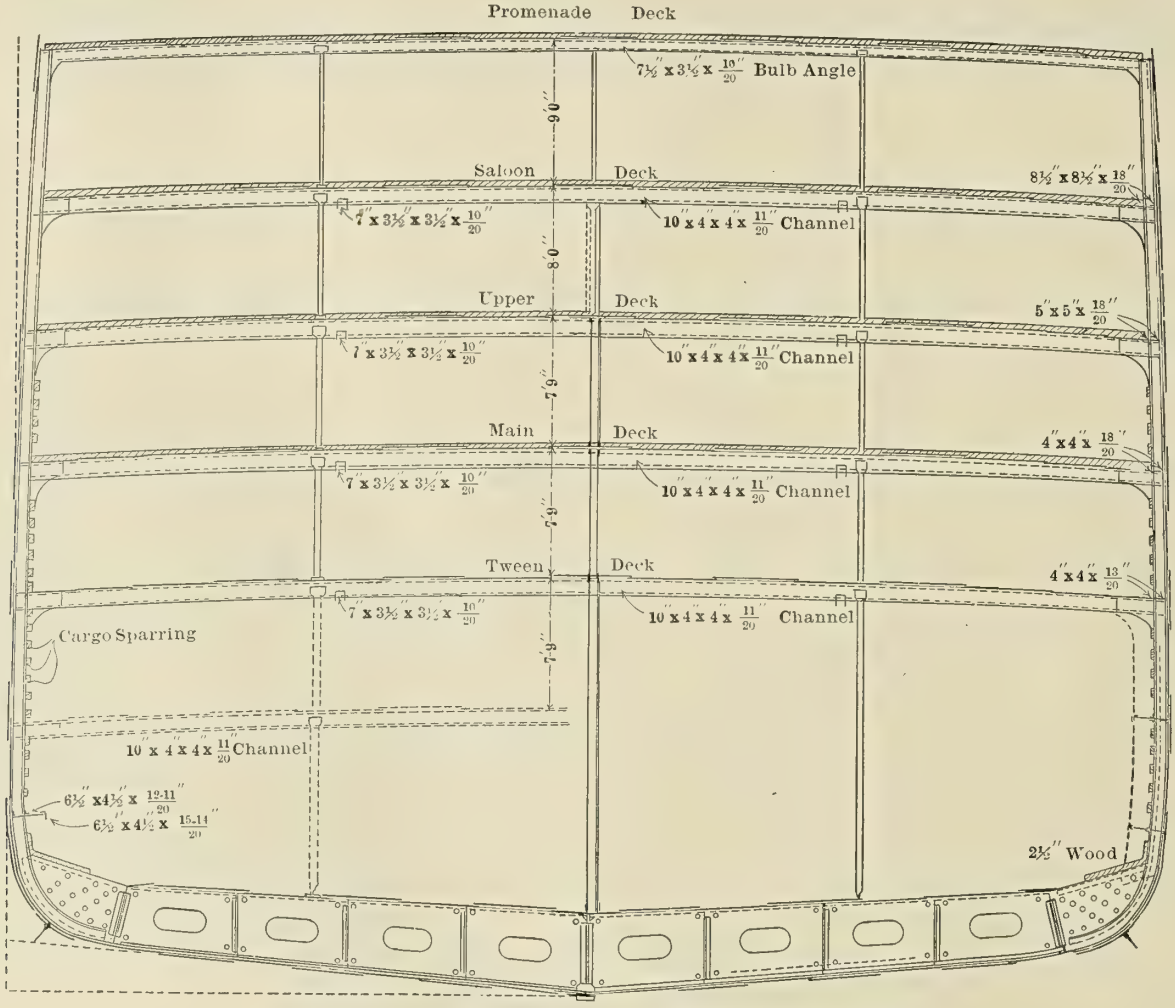
to main deck, 4⅜ inches; from main deck to saloon deck, 3½ inches; and from saloon deck to promenade deck, 3¼ inches. All

Wood deck planking is fitted on main, upper, saloon and promenade decks, being of 5 by 3-inch material on the main deck; 5 by 3½-inch pitch pine on the upper deck; 5 by 3½-inch yellow pine on saloon deck and 4 by 3-inch yellow pine on promenade deck. The deck spacing from top of beam to top of beam measures 7 feet 9 inches from platform to 'tween deck, 'tween deck to main deck and main deck to upper deck. From upper deck to saloon deck it is 8 feet, and from saloon deck to promenade deck 9 feet.

The double bottom measures 4 feet 8 inches deep in the center of the ship, and is fitted with fore-and-aft watertight bulkhead. It has a total capacity for ballast and feed water of 2,810 tons, while the tank fitted for drinking water has a capacity of 800 tons. In addition to this, the lower part of hold III is fitted as a deep tank, with a capacity of 1,330 tons of water, the space being also available for cargo. Adding the capacities of the fore and aft peaks, the total water capacity of the ship is 4,200 tons.

PROPELLING MACHINERY.

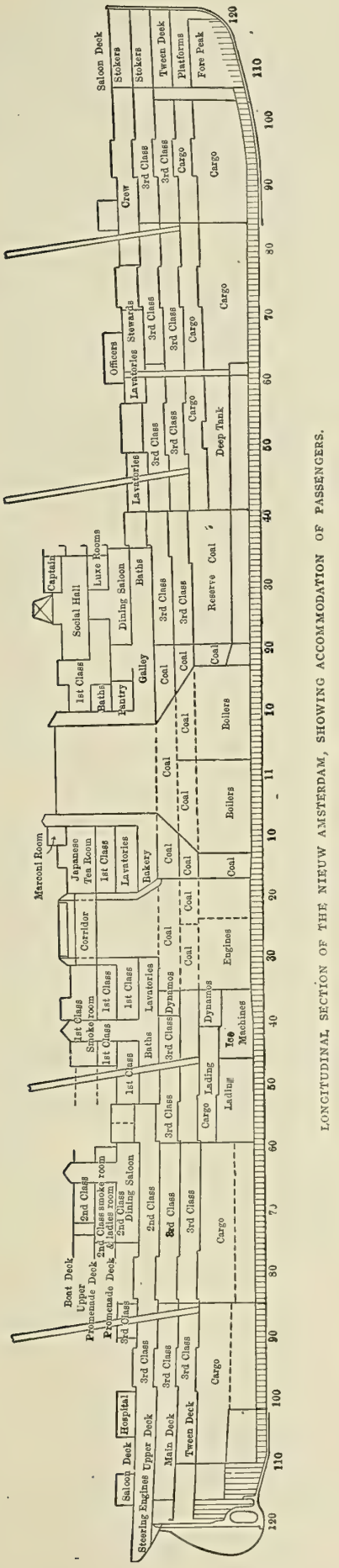
The ship is propelled by twin screws actuated by two quadruple expansion engines of the usual vertical inverted direct acting type, balanced upon the improved Yarrow-Schlick-Tweedy system and capable of developing each about 5,200 indicated horsepower at 80 revolutions per minute. The cylinders measure respectively 29, 41½, 61 and 87 inches in diameter, with a common stroke of 60 inches. The cylinder positions from forward are: high-pressure,


Promenade Deck
7½" x 3½" x 10/20" Bulb Angle
9'-0"
Saloon Deck
8½" x 8½" x 18/20"
7" x 3½" x 3½" x 10/20"
10" x 4" x 4" x 11/20" Channel
8'-0"
Upper Deck
5" x 5" x 18/20"
7" x 3½" x 3½" x 10/20"
10" x 4" x 4" x 11/20" Channel
7'-9"
Main Deck
4" x 4" x 18/20"
7" x 3½" x 3½" x 10/20"
10" x 4" x 4" x 11/20" Channel
7'-9"
Tween Deck
4" x 4" x 13/20"
7" x 3½" x 3½" x 10/20"
10" x 4" x 4" x 11/20" Channel
7'-9"
Cargo Sparring
10" x 4" x 4" x 11/20" Channel
6½" x 4½" x 12-11/20"
6½" x 4½" x 15-14/20"
2½" Wood

MIDSHIP SECTION OF THE SHIP, SHOWING FRAMING AND DECK BEAMS.

are spaced 7 feet 7½ inches apart. Over the portions of the ship not provided with platforms the quarter stanchions extend from tank top to 'tween decks, and are 5½ inches in diameter.

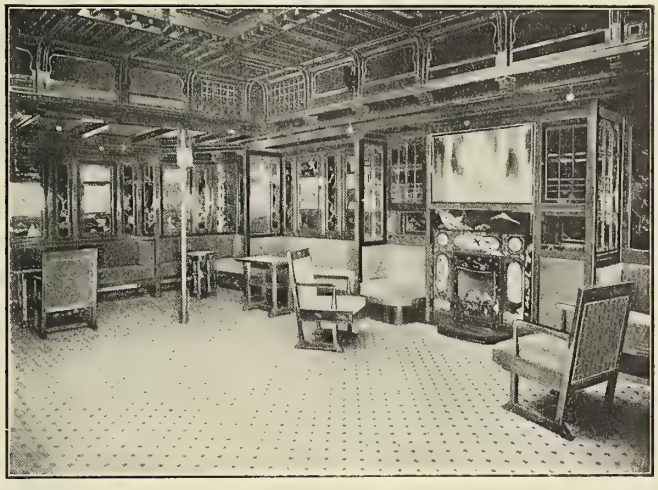
second intermediate, low-pressure, first intermediate. The crank sequence shows high-pressure, first intermediate, second intermediate and low-pressure, with angle between high-pressure and



LONGITUDINAL SECTION OF THE NIEUW AMSTERDAM, SHOWING ACCOMMODATION OF PASSENGERS.

first intermediate 62 degrees; between first and second intermediate cylinders, 96 degrees; 106 degrees from second intermediate to low-pressure, and then 96 degrees completing the cycle back to the high-pressure cylinder.

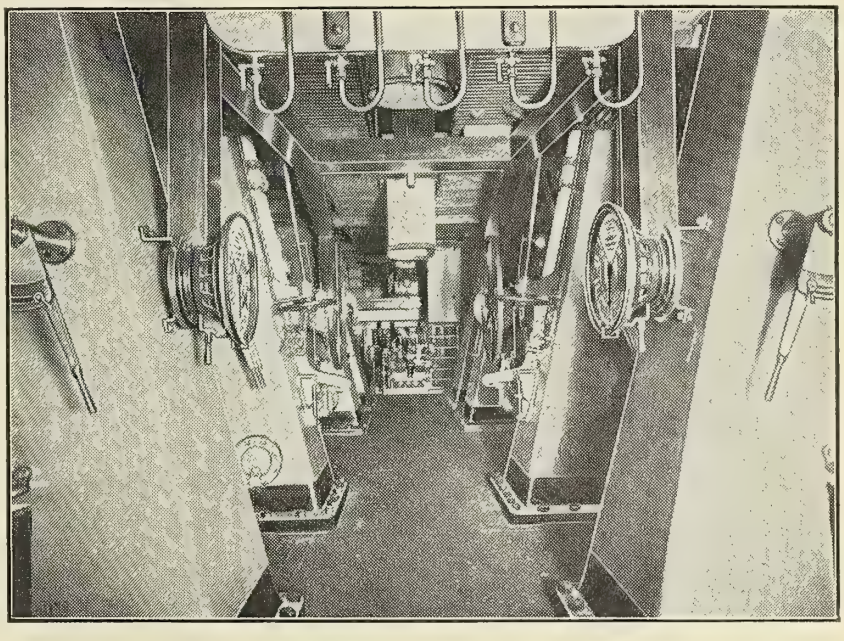
The high-pressure and first intermediate cylinders have each one piston valve, the second intermediate cylinder is served by two such valves, and the low-pressure cylinder by a large slide valve with balance piston on top. All of the valves are actuated



A CORNER OF THE JAPANESE TEA ROOM.

by means of eccentrics operating with Stephenson link motion of the double bar type. The high-pressure and first intermediate pistons and valve rods pass through glands using United States metallic packing. All of the pistons of the main engines are provided with Lockwood and Carlisle's piston springs.

The shafting, all of which is made of Siemens-Martin steel, has a total length of 252 feet 6¼ inches. The crank pin diameter is 18 inches, crank shaft 17½ inches, thrust shaft 17¼ inches,



THE STARTING PLATFORM IN THE ENGINE ROOM.

line shaft 16½ inches and propeller shaft 17¾ inches. There are eight collars on the thrust shaft, the total thrust surface being 2,020 square feet. The propellers, which are three-bladed, and of manganese bronze, have a diameter of 18 feet 6 inches and a pitch of 23 feet; a pitch ratio of 12.42 being thus obtained. The developed surface of each propeller is 84¾ square feet.

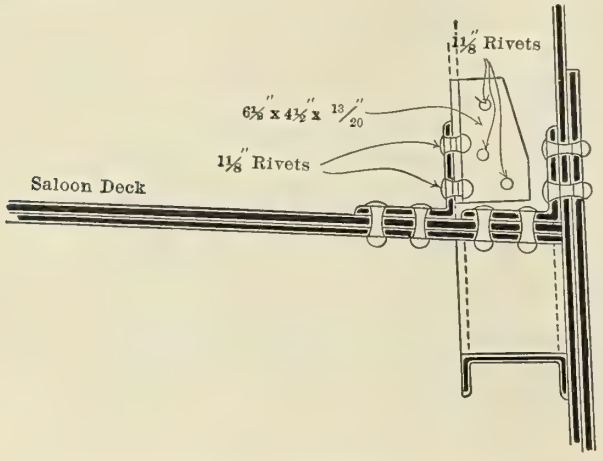
The two main engines are in a single engine room without center line bulkhead, the starting platforms being conveniently located between the engines, and in plain view of the telegraphic signals from the bridge. The entire outfit has ample space for the use of the engine room crew, without the crowded conditions so often noticeable on transatlantic ships. The main engines are supported upon hollow cast iron box columns, eight in number for each engine, the condensers being incorporated with the back columns. The front columns are utilized for oil storage,

THE DUTCH FIREPLACE IN THE SMOKING ROOM.

and are provided with taps for drawing off oil as needed. The main steam pipes are all of wrought iron, lap-welded, with flanges welded solid to the pipes.

BOILERS.

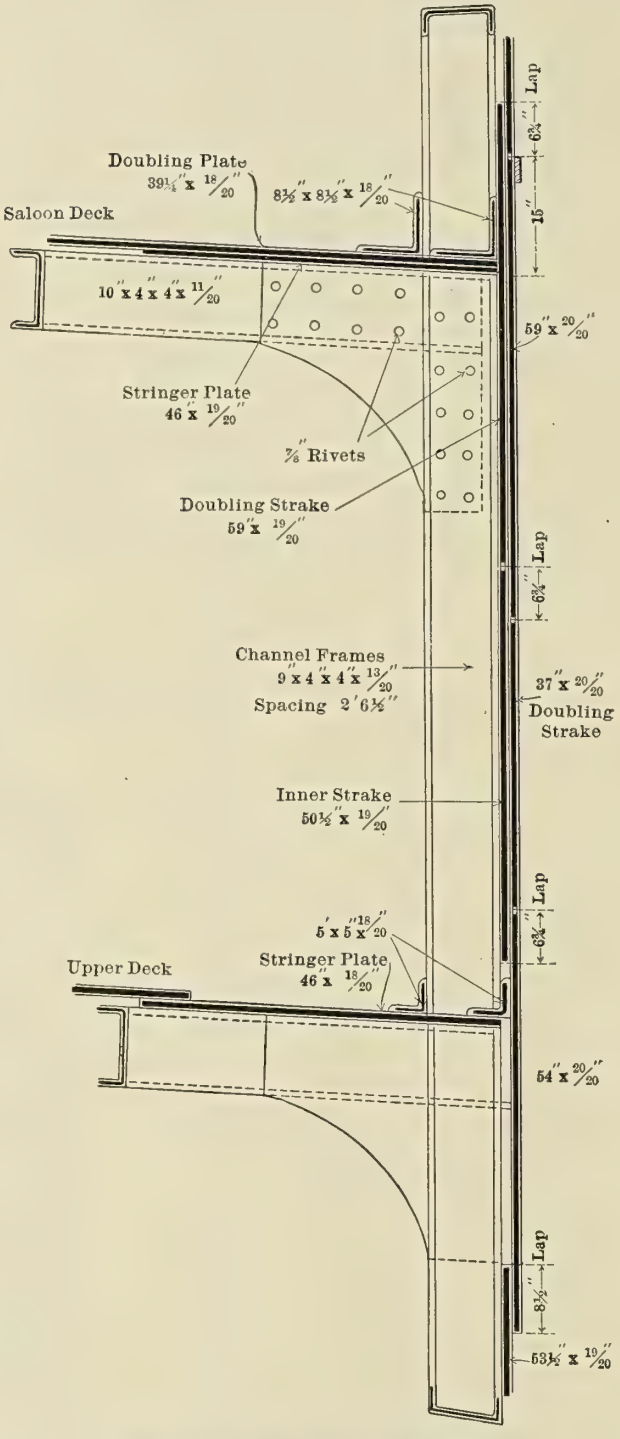
There are seven steel double-ended boilers of the familiar Scotch or cylindrical type, operating at a pressure of 215 pounds per square inch. These boilers are located in two boiler rooms, separated by a watertight bulkhead to the level of the main deck, or well above the water line. The forward boiler room contains three boilers side by side, with a fire room at each end, while the after boiler room has four boilers similarly situated. The products of combustion from all of the seven boilers go into a single stack.



DETAIL SHOWING STRINGER CONNECTION TO SHEER STRAKE.

Each boiler has three furnaces in each end, making a total of forty-two fires. The boilers have a mean diameter of 15 feet, a length of 19 feet 6 inches and are fitted with shells of a thickness of 1 29-32 inches. Each boiler has 732 tubes of a diameter of 2¾ inches. The furnaces, which are of the Purves type, have grates 5 feet 6 inches long and 3 feet 6⅞ inches wide; this gives a grate surface per boiler of 118 square feet, and a total of 826 square feet; while the heating surface in each boiler figures out at 4,543 square feet, and the aggregate heating surface, 31,801 square feet; the ratio being 38.5 to 1.

The funnel is of elliptical section, and consists of inner and outer tubes with air space of 10½ inches between them. The outer tube has a long diameter of 17 feet 1 inch and a short diameter of 13 feet 5 inches, while the inside tube has similar dimen-



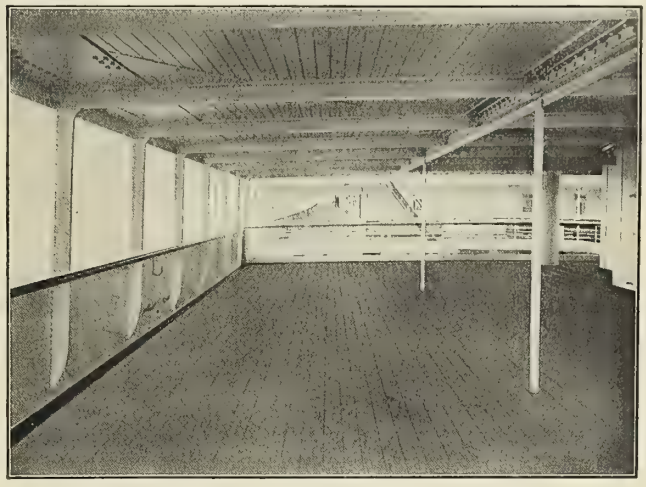
THE GENERAL CONSTRUCTION OF THE UPPER SIDES.

sions 15 feet 4 inches and 11 feet 8 inches respectively. The height of the funnel above the grates on wing furnaces is 118 feet 2 inches. Natural draft is used, but two fan engines are fitted for ventilation, and for slight induced draft when necessary.

AUXILIARY MACHINERY.

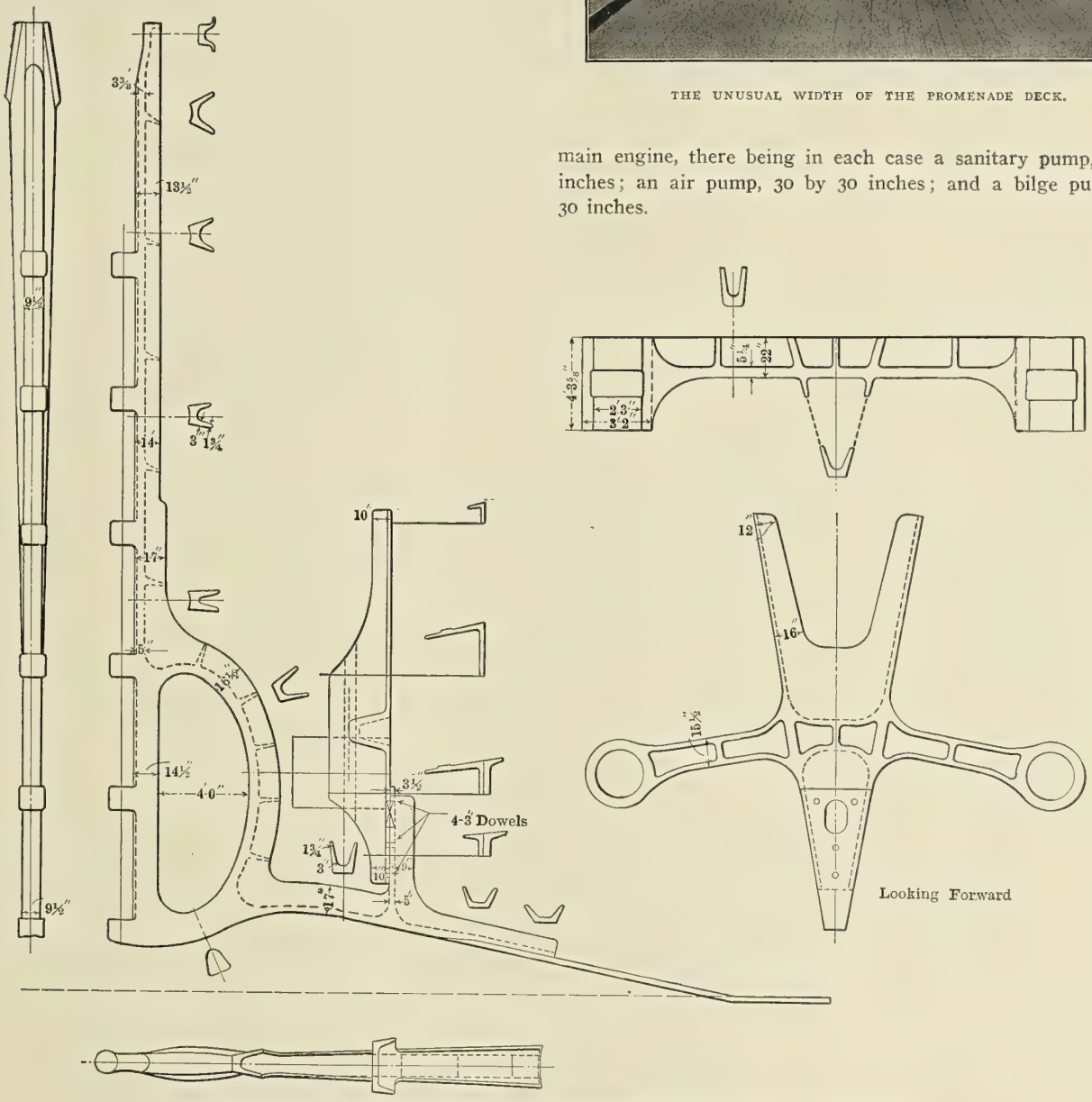
The two main condensers have cooling surfaces amounting to 6,430 square feet each, while the auxiliary condenser has a cooling surface of 2,000 square feet. The Weir's pumps on the main condensers have cylinders measuring 15½ and 11½ inches respectively in diameter, with a stroke of 26 inches. For the auxiliary condenser the air pump measures 9 and 15 inches by 12 inches. The circulating pumps in each case are centrifugal, the two for the main condensers being operated each by a steam cylinder of 11 inches diameter and 10-inch stroke with a pump runner 16 inches in diameter; for the auxiliary condenser the engine is 6 by 7 inches with an 8-inch pump runner.

Three duplex pumps are fitted to be used when needed for boiler feed, pumping bilges, operating ash ejectors and as sanitary pumps; each has steam cylinders 10½ inches in diameter with water cylinders 7 inches and with stroke of 12 inches.



THE UNUSUAL WIDTH OF THE PROMENADE DECK.

main engines, and operated by means of beams whenever the main engines are running. Three of these are fitted to each main engine, there being in each case a sanitary pump, 5 by 30 inches; an air pump, 30 by 30 inches; and a bilge pump, 6 by 30 inches.



THE STERN FRAME AND RUDDER POST, WITH SPECTACLE FRAME AND KEEL CONNECTION.

Four other duplex pumps are fitted, two for sanitary purposes having cylinders 8 and 9½ inches by 10 inches, while the other two, which are used for pumping drinking water from the tanks in the double bottom, measure 5¼ and 4 inches by 5 inches. The two ballast pumps measure respectively 14 and 15 inches by 14 inches and 12 and 10 inches by 14 inches. In addition to these independent pumps, there are six pumps connected to the

The two starting engines have each two cylinders 7½ by 7½ inches. The turning engines have each two cylinders 7 by 7½ inches; the two Wilson and Pirrie steering engines have each two cylinders, 13 by 14 inches; the anchor engine has two cylinders, 15½ by 16 inches. Other engines include that for the ash hoist, which measures 5 by 7½ inches; a mooring engine aft, measuring 10 by 16 inches; two fan engines in the stoke hold,

each 6½ by 5 inches; and fourteen cargo winches, 8 by 11 inches.

There are two refrigerating engines operating on the J. & E. Hall carbonic acid system, one having a compound engine, 7 and 14 by 9 inches, while the other has a simple engine 8 by 9 inches. From these engines the refrigerant is circulated through the various compartments as needed. The feed filter is of the Raylton & Campbell pattern, while a Quiggins feed heater is installed. The Weir's evaporator has a capacity of 50 tons per day, while two distillers are fitted, with a capacity of 20 tons each.

THE EQUIPMENT.

The ship is lighted throughout by electricity, which is also utilized for heating purposes in a number of public rooms and in the suites de luxe. This electricity is generated by four dynamos supplied by William H. Allen, Sons & Company, of Bedford, England. The engines driving these generators are compound, with cylinders 9 and 15 inches in diameter and a stroke of 9 inches, and are coupled direct to the multipolar dynamos, which operate at 110 volts at a speed of 300 revolutions per minute, the output of each dynamo under full load being 263 amperes. All of the machines are placed aft of the engine room, three being immediately over the thrust bearings, while the fourth is above the water line. The main switchboard is placed alongside the three machines, while an auxiliary board is fitted near the other. The total number of lights utilized is about 1,500, while electricity is used for a great many other purposes, including ventilating fans, telephones, a complete bell system, etc. There is also a wireless telegraphy equipment on the Marconi system fitted in a special house on the boat deck.

The equipment includes Hall's patent anchors, weighing 6,700 kilograms (14,750 pounds) each, with 3¼-inch anchor chains. The mooring anchors aft weigh each 2,600 kilograms (5,730 pounds) with 2-inch chains. The total number of lifeboats is twenty-four, of which eighteen measure 28 feet 6 inches by 8 feet 6 inches by 3 feet 6 inches; four measure 28 feet 6 inches by 8 feet 6 inches by 2 feet 6 inches; and the other two are 24 feet by 6 feet 6 inches by 2 feet 6 inches. The rudder stock has a diameter of 15 inches, while the framing consists of four sections with broad horizontal palms for connecting each to the next. These palms have a thickness ranging from 2½ to 3½ inches over the various portions. The rudder is hung from six pintles.

For many of the structural details and the drawings we are indebted to *De Ingenieur*.

Steamship Earnings.

The Cunard Steamship Company reports for the calendar year 1905 gross earnings amounting to $8,866,340 as against $7,443,800 for 1904. This increase of $1,422,540 represents a gain of 19 percent. The year as compared with the previous one was much better, however, than these figures would indicate, because of the fact that the net earnings increased from $748,195 in 1904 to $1,533,000 in 1905, this increase being 110 percent. In place of no dividend at all in 1904 a dividend of 4 percent was declared in 1905; after charging to reserve in the latter year the sum of $234,300, an item which did not appear in 1904, a surplus of $35,500 is carried forward to 1906. This statement indicates a very satisfactory condition of the company.

The Hamburg American line, after a very successful year, has paid dividends amounting to 11 percent on the capital stock of $23,800,000. A balance of $270,000 is carried forward to 1906. The company operates 349 vessels, of which 157 are ocean steamers. The aggregate tonnage is 811,943, a figure only slightly less than that of the entire foreign service merchant marine of the United States.

STEEL BARGES.*

BY RICHARD J. DONOVAN.

In opening this discussion I will present some facts concerning river transportation, that we may get some idea of the conditions of service met with in this business. We may divide the business of transportation into two general classes: First, that which pertains to bulk quantities, including such staple articles as coal, steel, grain, etc.; second, that which pertains to package quantities, including the general run of merchandise which may come in some form of package, or in quantities which will not warrant special shipment. We find that, in the case of the first class, viz: bulk quantities, the problem consists in simply loading the article considered in some type of carrier and delivering at some destined river port, without breaking or shifting individual cargoes. With the second class, viz: package freight, there is more or less shifting or breaking cargo, with additions or subtractions at various points.

Of course the handling of bulk quantities is by far the most interesting problem to the engineer, and it is here that the observer is astonished at the magnitude of such individual movements on our rivers. For the benefit of those of us who are not sufficiently acquainted with the volume of traffic on the Ohio river, it may be interesting to present a few facts concerning this matter. The total navigable mileage of the Ohio and all its tributaries is about 4,400 miles, the Ohio itself being about 1,000 miles from Pittsburg to Cairo, where it empties into the Mississippi.

The gross freight movement on this vast waterway system amounts to about 11,000,000 tons per year, the coal from our Pittsburg district constituting about half of this tonnage. In handling this enormous business, there are employed about 480 steamboats of all descriptions, and some 6,000 or 7,000 barges. I might add that one company here in Pittsburg, the Monongahela River Consolidated Coal and Coke Company, owns upward of 100 tow boats of all descriptions together with 3,000 barges, and ships annually about 4,000,000 tons of coal.

The various types of carriers used on this great system may be divided into two classes: First, those provided with their own propelling machinery, such as the stern and side wheel steamboats; second, all carriers that have to be towed or moved by external means, such as the coal barge, or decked merchandise barge. We would here note that there are a large number of craft used in maintaining traffic, such as dredges, snag boats, derrick boats, repair and pump boats, etc., which we will touch on later. These two general classes are the result of many years' experience and hard thought on the part of those engaged in the river business, and the types adopted are peculiarly fitted for the service.

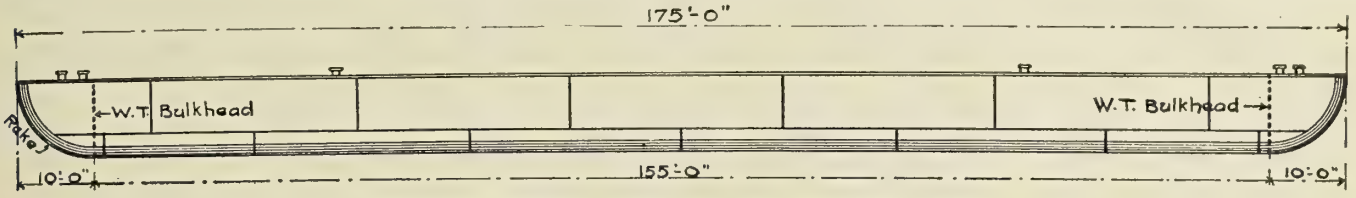
The final result in any design for a carrier on any waterway system is a compromise between adaptability for certain speed, draft of water available and carrying capacity required, there being of course many other details peculiar to the service conditions.

The requirements for a river steamboat then may be briefly stated to be (taking first the case of the packet steamer) such speed as has been found economical for the service engaged in, the least possible load draft, and such freight and passenger capacity as the usual run of business would warrant. In the case of the tow boat, large reserve propelling power is an important item, and due to the fact that coal barges leak more or less, there must be a large excess in boiler capacity for the purpose of operating the steam siphons which are used to keep the tow clear. The under water parts of the tow boat hull are, as a rule, not so fine as a packet boat, that is, they are not formed for such speed. They are not intended to carry cargo,

*Paper read October 24, 1905, before the Engineers' Society of Western Pennsylvania.

and the accommodations provided are generally but little in excess of those required by the crew. The boats are well supplied with all kinds of appliances and machinery for handling the tows, and in the intricate and shallow channels are admirably suited for the purpose intended.

In bulk transportation we have seen that coal is far in the lead as a staple product, and we will now present a short account of the carriers used in this trade. These carriers are divided by the rivermen into two classes known respectively as the "barge" and the "boat", both of which are rectangular in plan and resemble large open boxes. The ends of both are usually curved or raked, from the bottom to the head blocks, as the ends which take the bumps and shocks are called. Bulkheads are fitted in some at each end, separating the rake end from the main cargo space. The barge is mainly used in the Cincinnati and Louisville trade, while the boat is employed almost exclusively in the Mississippi river business. The barge is usually about 135 by 26 by 8 feet, and will carry between 15,000 and 16,000 bushels, or nearly 600 tons, on a draft of about 6 feet 6 inches. The boat is usually about 170 by 28 feet by 8 feet 6 inches, and will carry about 25,000 bushels, or 950 tons.



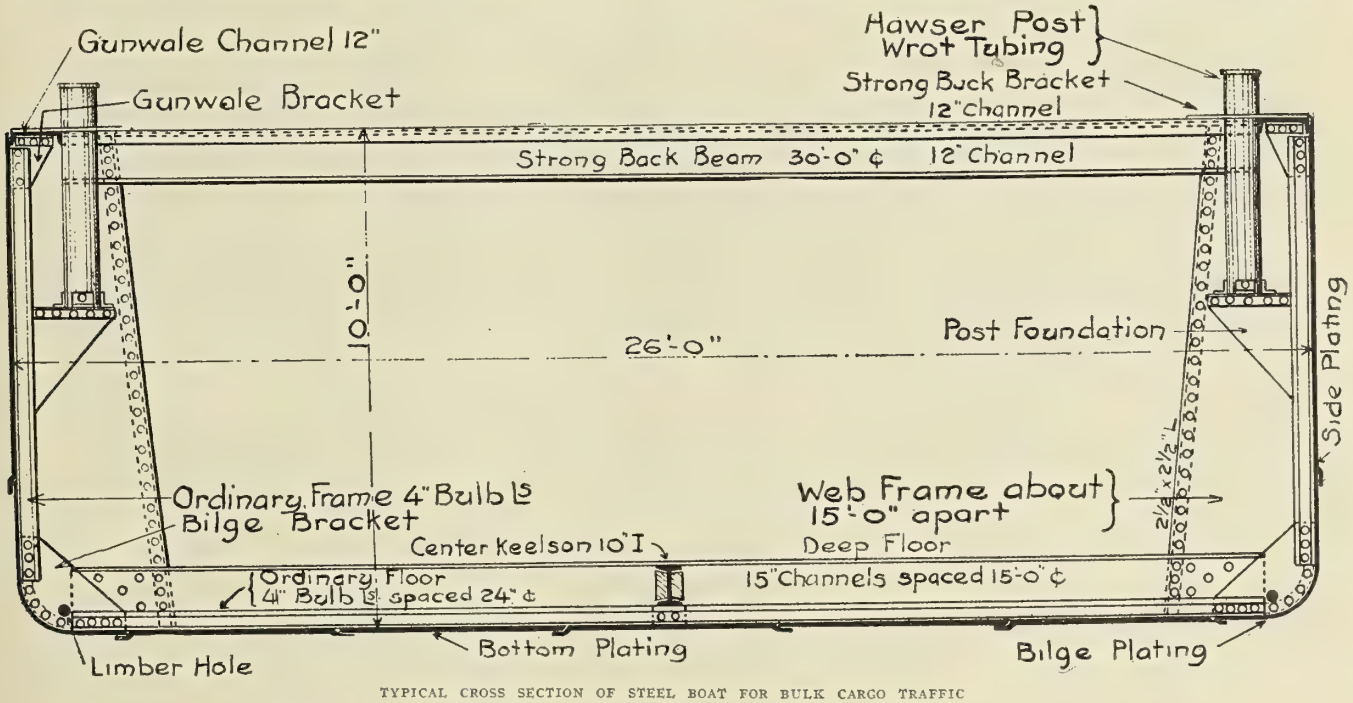
LONGITUDINAL ELEVATION OF STEEL BOAT FOR RIVER TOWING SERVICE.

The barge is built in a very substantial manner and will last for some time, but the boat is merely thrown together and can stand but little hard usage. For some kinds of cargoes, such as sand and bulk merchandise, deck barges are used. These are of various dimensions and built to stand the hardest usage.

There is also a very important business on the Mississippi river in the transfer of railroad cars from side to side. These car ferries or transfer boats are generally of large dimensions and are supplied with their own power. There are also in use a number of transfer barges built in the most substantial manner especially for this business.

Up to the present time, wood has held its own in river construction on account of its cheapness, for the wooden structure costs but one-half to one-third as much as the steel structure. However, suitable timber is becoming very costly on account of its scarcity, and the large operators are beginning to investigate the relative advantage of steel for their transport fleets. At present there are several examples in steel of the various types discussed operating on the Ohio river, and experience has shown that the steel hull is far superior to the wooden hull in low cost of upkeep, while its life is double that of the wooden.

We will now examine the construction of a typical steel river steamboat. The general principle involved in the construction of any type of boat is usually embodied in arranging a longitudinal "backbone" consisting of longitudinal bulkheads, keelsons and stringers. At right angles to the backbone is arranged a system of "ribs" or transverse members, consisting of floors, side frames, deck beams and cross-bulkheads. The shell, or outside plating, is then riveted to the skeleton frame. The



TYPICAL CROSS SECTION OF STEEL BOAT FOR BULK CARGO TRAFFIC

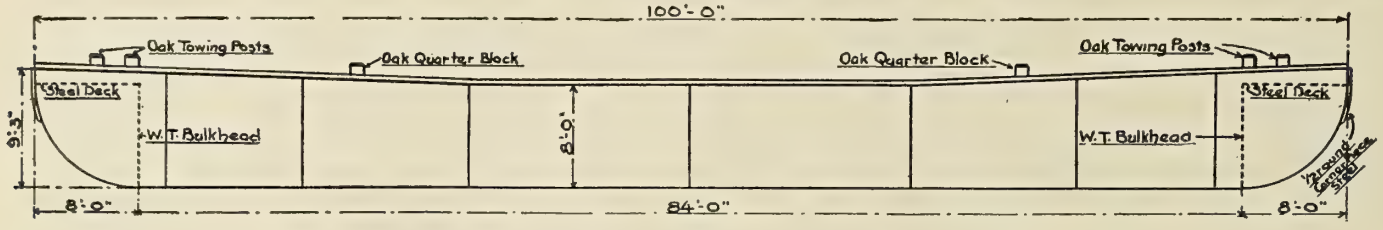
bulkheads and shell plating are fitted watertight, this being accomplished by proper spacing of rivets and judicious use of calking tools. Some very interesting construction is required to insure watertightness, but as a rule, in shallow draft river crafts, the water pressure is so low that it is not at all difficult to solve the problem. A complete, or partial, steel deck is usually provided, and on this steel foundation the wooden cabin and upper works are built.

There is also usually provided a "hog chain system" to insure longitudinal strength. This is a truss arrangement

consisting of a square or round section rod carried over tube or timber bracing and leading from the bow of the boat to the stern. It usually projects above the cabins and is quite prominent. The aim is to make the structure as light as possible consistent with the required stiffness and strength for the service conditions.

The following general description refers to a type of steel coal barge of which a number have been built and are now in use.

The steel plating used in these barges is all about ¼ inch in thickness, and the ribs consist of channels and angles fitted alternately, except the side frames, which are angles. A steel



OUTBOARD PROFILE OF STEEL BARGE, AS USED ON THE OHIO RIVER.

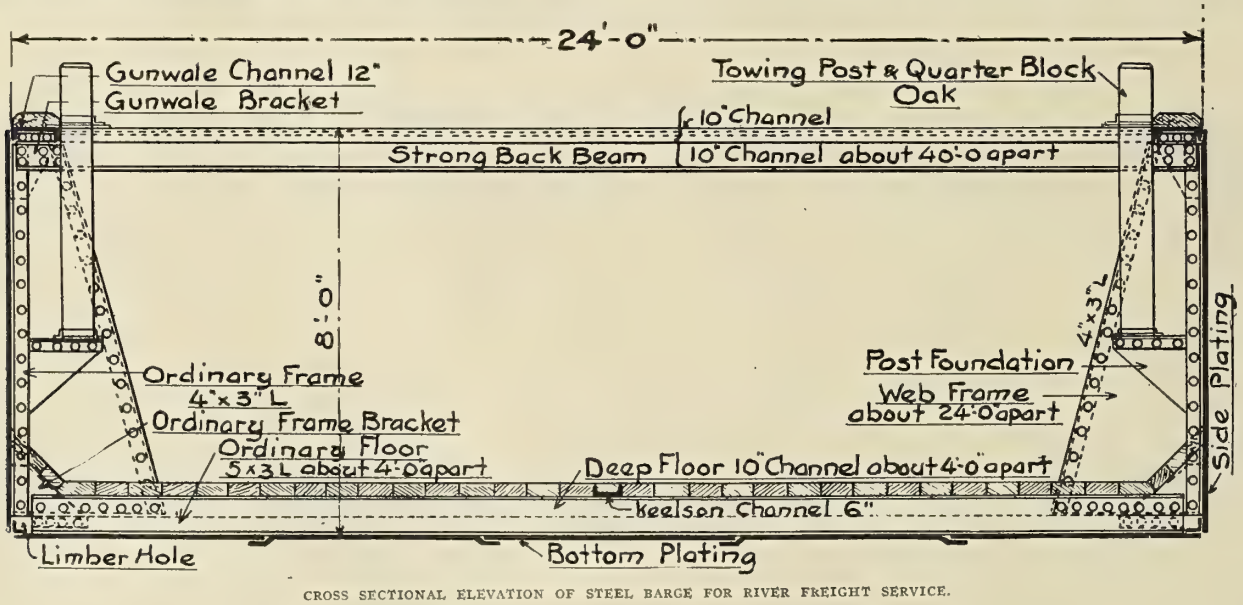
It is perfectly feasible to make an analytical study of the structure of a boat, but in river work such an investigation, using the sizes and sections fitted in the best work of this kind, would show a most amazing confidence in steel, and would probably deter the exact scientific engineer from competing in this line of work. The tow boat hulls are made much stronger than the packet boat hulls, since they have to stand much harder usage in every way, besides carrying much heavier machinery.

Now let us consider a steel open "boat" or "barge" for the transportation of coal. The same principle is carried out here as in the case of the steamboat hull—viz, the backbone and rib

watertight bulkhead is fitted at each end of the cargo space, and a steel handling deck is arranged from top end of bulkhead to head block. A heavy channel is fitted at the top of the side plating for lateral stiffness, and strong beams are fitted across the open cargo space at the quarter block or hawser posts. As the clamshell, or unloading bucket, is used in taking out the coal, a wood flooring, or ceiling, is laid on the channel floor beams, thus presenting a smooth surface for the unloader.

These barges have given good satisfaction to the owners and are said to hold about 80 tons more coal than the wooden barge of the same dimensions and draft.

In the construction of steel deck barges, care must be taken



CROSS SECTIONAL ELEVATION OF STEEL BARGE FOR RIVER FREIGHT SERVICE.

construction—but here we have to depend more on the sides of the boat or barge acting as the backbone or longitudinal girder—for the interior or hold space must be available for cargo. The ends are usually curved up to heavy end construction known as the head block, which takes the bumping and blows incident to the rough service. This curved part is called the "rake" by rivermen, and is introduced to ease the passage of the boat through the water. At the foot of the rake at each end, a watertight cross bulkhead is usually fitted for safety purposes. The framing of the rake must be of a very substantial character, as it is here that the barge suffers most. The ribs are spaced about 2 feet apart in the cargo space, and at certain intervals there are beams fitted across the barge to stiffen the sides. The barge is merely a shell, and of course some judgment must be used in unloading or loading the cargo in order to place no undue stresses in the structure.

to make the internal framing sufficiently strong to care for the general longitudinal stresses, and also for those that are local. The conditions of service met with in dredge hulls are such that usually the local loading and stresses are very high, so that we have to deal not so much with general as with local stiffening; but the general construction of such hulls is identical in principle with that which we have already discussed.

In the matter of upkeep, the preservation of steel plating and framing from oxidization is of the highest importance, and it is here that a great deal of trouble and expense is incurred. Due to there being so many manufacturing plants established on the banks of the rivers forming the Ohio, large quantities of acid matter are drained into the water, giving rise to conditions which are highly injurious to the life of the steel river craft. The use of some good protective paint or covering is imperative, but such a paint is hard to find. There are,

however, some such coverings which seem to hold in check this acid to a marked degree.

At present the business of transportation on the Ohio river is a speculation, depending entirely on the stage of water. The government is working to improve this state of affairs by a series of locks and dams along the whole length of the river. In time, it is hoped, an eight- or nine-foot stage of water will be available the whole year, but it is said that this work will cost nearly $100,000,000 and will require about one hundred years for completion. In the old days before the Civil War, the Mississippi and Ohio rivers were crowded with packets and freighters, and an enormous river business was carried on, but the railroads have now taken over the most of this traffic, and the rivers are lined with the decaying remains of this once vast fleet.

ABSTRACTS OF DISCUSSION.

It is sometimes desirable to have a flexible construction. In car ferries, however, they make the bulkheads of girder construction to stand the strain.

Up to date there are only a couple of steel barges in use, and I understand that the only precaution against the action of the coal is to coat the inside with heavy oil. On some barges that have been built for carrying coal there has been used a special acid-proof paint. Of course the barges have not been in use long enough to judge whether the paint is a sufficient covering to protect it against this action. But it is entirely possible to protect steel against any action arising from the sulphur in the coal.

The steel barge would have to be dried out, or docked, at least once a year for examination and painting. It has been my experience with boats carrying a much larger tonnage than the ones under discussion that this has been sufficient. I think a good graphite paint as good as anything. The wooden ceiling is laid in such a way that it can be taken out. This should be done once a year.

When you have a barge sunk, or grounded, in the channel of the river, it will not be any harder to raise a steel barge than a wooden one. When the wooden barges sink most of them go to pieces. With a steel barge you can bulkhead it up, or put chains under it and raise it that way. They will sink just the same as wooden barges. They will not, however, leak so badly. Wooden barges, after four or five years' use, require a great deal of money to keep them in repair.

In winter time, for running through ice the steel barge is what is wanted. At the present time we have to sheet the wooden barge with iron, and when the ice is heavy we string out the barges, put the boat in the front and back it down. That wears the wheels out. About the second trip we have to rebuild the wheels.

As to the form, a long rake on the boats makes them a little easier to tow, while a round corner as they have on the boats at Ambridge is a great advantage in the lock. If we go in with a full head of steam, as we have to do when there is much wind in order to get the boats in at all, we generally put four barges in the lock at one time. If we strike the lock with a square corner the barge will be thrown around and block the lock, but if there is a round corner, it will slip off.

COMPARISON OF THE FRENCH AND GERMAN NAVIES.

(FROM THE REPORT OF THE FRENCH MINISTER OF MARINE.)
BY J. PELTIER.

During the past year the attention of the French parliament has been called to the considerable increase in the power of the German navy. The English navy is manifestly too superior to the French to furnish any proper element of comparison, and we will confine ourselves to an examination of the two fleets which, but recently of very different powers, have each day become more and more nearly equal: the French navy and the German navy.

THE AMERICAN MERCHANT MARINE ; SCENES IN NEW YORK HARBOR.

At the present time there are in France twenty-one battleships, eleven of the first class and ten of the second class; nine armored coast defense vessels, all of slight value; eight armored gunboats; eighteen armored cruisers of the first and second class; thirty-three protected cruisers of all classes; one torpedo depot ship; forty-three torpedo-boat destroyers; nine torpedo cruisers; forty high-sea torpedo boats; one hundred and eighty-two torpedo boats of all classes; twenty-seven torpedo boats allotted to the colonies; six submersibles and twenty-nine submarines.

Germany possesses twenty-four battleships, of which nineteen have been built since 1890; eight armored coast defense ships; twelve armored gunboats; six armored cruisers, entirely new; thirty-six large and small cruisers; ten old torpedo cruisers; thirty-seven torpedo destroyers; seventy-eight torpedo boats; besides a number of submarines under construction and three authorized.

At first view the French navy appears somewhat superior to the German, particularly if we consider the total number of different units, but we must notice that on the side of France the difference consists entirely in a large number of small units. In fact, if we consider solely the large battle units, we find a

number of battleships superior by three in favor of Germany. Table I shows the actual differences existing from the point of view of armament and of speed. This table shows that France has twenty-one battleships against twenty-four, and that of the

TABLE I.

French Battleships	Year	Tonnage	Speed	Battery: Heavy	Mean	Light
Suffren	1902	12,728	16.5	4	18	24
Iéna	1900	12,081	17.4	4	16	22
Masséna	1897	12,316	15.5	4	16	20
Bouvet	1897	12,000	16.5	4	16	20
Carnot	1896	12,146	16.0	4	8	28
Charles Martel	1896	11,881	16.5	4	8	27
Jauréguiberry	1896	11,889	16.0	4	8	28
Charlemagne	1897					
Gaulois	1898	11,280	16.5	4	18	24
Saint Louis	1899					
Brennus	1894	11,370	15.0	3	10	25
Henri IV	1902	8,949	15.0	2	7	14
Hoche	1889	10,997	14.0	4	12	23
Magenta	1892					
Marceau	1889	10,900	14.0	2	8	26
Neptune	1891					
Formidable	1887	11,600	13.8	2	18	28
Amiral Baudin	1886					
Courbet	1885	10,620	13.8	7	11	26
Dévastation	1881			6	10	14
Redoutable	1877	9,372	13.5	8	6	23
Total	21	236,709	15.2	80	260	500

German Battleships	Year	Tonnage	Speed	Battery: Heavy	Mean	Light
Sachsen	1877-99					
Wurtemberg	1878-99	7,400	15.0	6	8	16
Bayern	1878-98					
Baden	1880-97					
Oldenburg	1884	5,743	13.5	8	2	13
Brandenburg	1891					
Kurfürst Friedrich Wilhelm	1891	10,662	16.5	6	14	20
Weissenburg	1891-04					
Wörth	1892-02					
Kaiser Friedrich	1896					
Kaiser Wilhelm II.	1897					
Kaiser Wilhelm der Grosse	1899	11,152	18.0	4	30	20
Kaiser Karl der Grosse	1899					
Kaiser Barbarossa	1900					
Wittelsbach	1900					
Wettin	1901					
Zaehringen	1901	11,832	19.0	4	30	20
Mecklenburg	1901					
Schwaben	1901					
Braunschweig	1903					
Elsass	1903					
Hessen	1903	13,200	19.0	4	26	20
Preussen	1903					
Lothringen	1904					
Total	24	258,911	17.6	116	520	457

French only fourteen are of a later date than 1890, even including the *Henri IV*, which belongs really to the coast defense line.

So far as displacement is concerned, the French battleships have a total slightly inferior, without taking account of speed, battery and homogeneity. Here the Germans have an overwhelming superiority. When it comes to speed, France has only a single ship of better than seventeen knots, while five of the German ships make eighteen knots and ten others make nineteen.

Comparing the batteries, France has eighty heavy guns against one hundred and sixteen for the German; in guns of medium-caliber France has only two hundred and sixty against the German five hundred and twenty, and their guns are of greater caliber and have heavier projectiles; in small caliber guns, France has five hundred as against Germany four hundred and fifty-seven, but the battle of Tsushima has decidedly discredited these small guns. The three-pounder gun, which forms the majority of the French small artillery, is considered in all navies as absolutely insufficient in size to be of much value.

When it comes to a question of homogeneity, all that is necessary is to glance at the table. Among the French ships there is almost a total dissimilarity of tonnage, armament and speed; while with the Germans the ships are grouped into classes of the same tonnage, armament and speed. It must be remembered that battleships in all navies are not only the principal force to be relied upon but perhaps the only force.

We will not institute a comparison in the details of the coast defenders. These ships have proved in the Russo-Japanese war to be of very little use, and form a certain amount of impediment to a fleet, which might have very serious consequence in the hour of battle. France possesses one more of this type of ship than does Germany, but the German ships are more homogeneous, better armed, and faster.

TABLE II.

French Armored Cruisers	Year	Tonnage	Speed	Battery: Heavy	Mean	Light
Jeanne d'Arc	1901	11,329	20.0	2	14	23
Leon Gambetta	1903	12,550	20.0	4	16	24
Gloire	1903					
Marseillaise	1902	10,014	19.5	2	14	22
Condé	1903					
Amiral Aube	1903					
Gueydon	1902					
Montcalm	1901	9,517	19.0	2	12	22
Dupetit Thouars	1904					
Dupleix	1902					
Desaix	1903	7,710	18.6		12	14
Kléber	1903					
Dupuy de Lôme	1893	6,783	19.0	2	6	20
Pothuau	1896	5,460	17.0	2	10	18
Latouche Treville	1894					
Chanzy	1894	4,800	16.3	2	6	16
Amiral Charner	1894					
Bruix	1895					
Total	18	147,049	18.8	32	198	345

German Armored Cruisers	Year	Tonnage	Speed	Battery: Heavy	Mean	Light
Fürst Bismarck	1897	10,690	18.5	4	22	18
Prinz Heinrich	1900	8,931	20.5	2	20	14
Prinz Adalbert	1901	9,050	21.0	4	22	14
Friedrich Karl	1902					
Roon	1903	9,600	21.0	4	22	14
Yorck	1904					
Total	6	56,921	20.5	22	130	88

With regard to the armored cruisers, the speeds given in Table II to the French cruisers are the maximum in service during a run of twenty-four hours; the speeds accredited to the German cruisers are those obtained on trial trip, which ought to be reduced by about a knot and a half for the comparison. This gives France a slight superiority. The Russo-Japanese war has not shown the utility of these ships, which are too large for scouts,

and too weak in battery and protection to take a place in the line of battle. France possesses here a considerable superiority in number, eighteen against six. But if we compare the units, it is seen that with a displacement about equal Germany has armored cruisers faster and better armed.

Let us take as an example the French cruiser *Gloire* and the German cruiser *Roon*. Both are of the same date. The German cruiser has a displacement slightly less, but it has the same speed in service. The *Gloire* has only two heavy guns and fourteen of medium weight as against four heavy and twenty-two medium, and though the French ship has twenty-two rapid fire guns to offset fourteen, this difference, as we said above, is rather apparent than real. As a result of this comparison, it may be affirmed that the German armored cruisers would be much better able to figure as units in the line of battle than would the French.

Comparing the protected cruisers of the first class as between the two powers in Table III, we notice the homogeneity and the

TABLE III.

French First Class Protected Cruisers	Year	Tonnage	Speed	Battery—Heavy	Mean	Light
D'Entrecasteaux	1898	8,123	17.5	2	12	18
Tage	1888	7,589	18.0		16	22
Cecille	1889	5,978	17.0		18	20
Guichen	1899	8,282	21.0		8	15
Chateaurenault	1900	8,025	21.0		8	15
Jurien de la Gravière	1902	5,692	20.0		8	16
Total	6	43,689	19.2	2	70	106

German First Class Protected Cruisers	Year	Tonnage	Speed	Battery—Heavy	Mean	Light
Kaiserin Augusta....	1892	6,320	21.6		20	28
Victoria Luise..... *Hertha* ..... *Freya*	1897	5,660	19.2	2	8	14
Hansa	1898	5,900	19.5	2	8	14
Vineta	1897					
Total	6	35,100	19.7	10	60	98

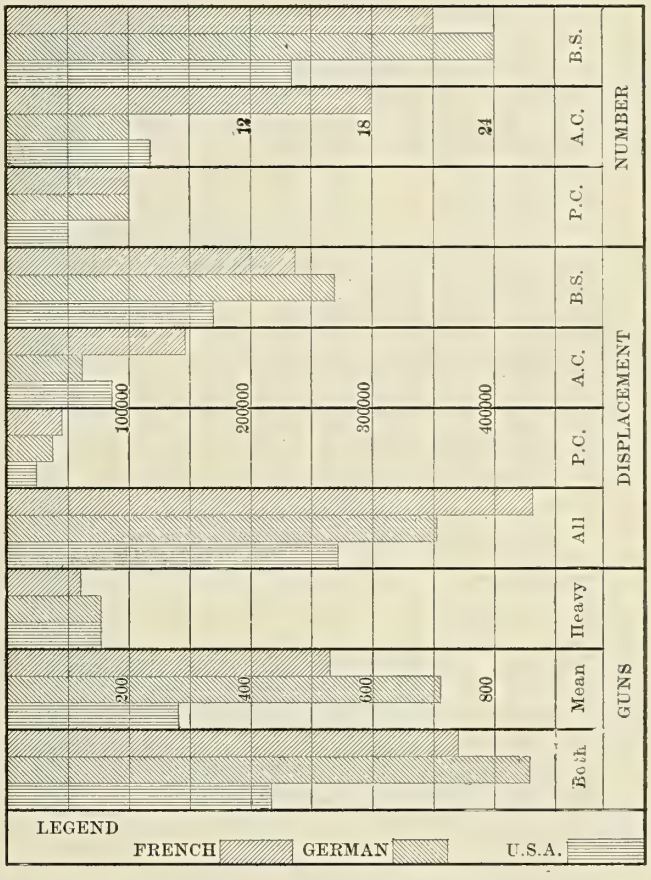
superior battery of the German ships. However, in the general total, these ships do not form a large factor of power. It was shown in the late war that when one of two fleets is defeated the cruisers may escape by virtue of their speed, but this does not prove that they possess any utility in the combat.

In the fleets of torpedo craft, France possesses an overwhelming superiority. This is shown by the fact that France has forty-three torpedo destroyers and nine torpedo cruisers against thirty-seven and ten respectively; forty high-sea torpedo boats, one hundred and eighty-two of the first class and twenty-seven for the colonies, a total of two hundred and forty-nine, against the German seventy-eight; and thirty-five submersibles and submarines as against several of the Holland type under construction for Germany.

The real value of this class of ship is problematical. It will suffice to say that in the late war in the Far East they have acted simply as accessories to the fleet. For a long time France has lived upon the belief that torpedo craft costing a million francs could blow up a battleship which cost forty millions; but facts do not seem to support this theory. However, the superiority of France is very evident, for her torpedo destroyers, high-sea torpedo boats and new submarines of large tonnage can very greatly assist the large units of power in their respective capacities.

The preceding comparison shows that France has an actual inferiority in large units. She has allowed herself to be overtaken and passed, and the question now is to regain the previous advantage. If we consider the French navy and the German navy as they will exist in 1908, we find that at that period France will have as a fleet of the first line seventeen battleships, fifteen armored cruisers of the first class and five of the second class. The second line will consist of eight battleships, nine coast defense ships, four armored cruisers of the second class and thirty-three protected cruisers.

The German act of June 14, 1900, provides for the German navy in 1908 in the first line twenty-seven battleships and eight first class armored cruisers. In the second line there will be eleven battleships, eight coast defense ships and forty-four protected cruisers. Again, it is necessary to note that the German ships will be in 1908 faster, better armed, and more homogeneous than the corresponding French ships. France cannot claim any advantage, the figures speak for themselves.



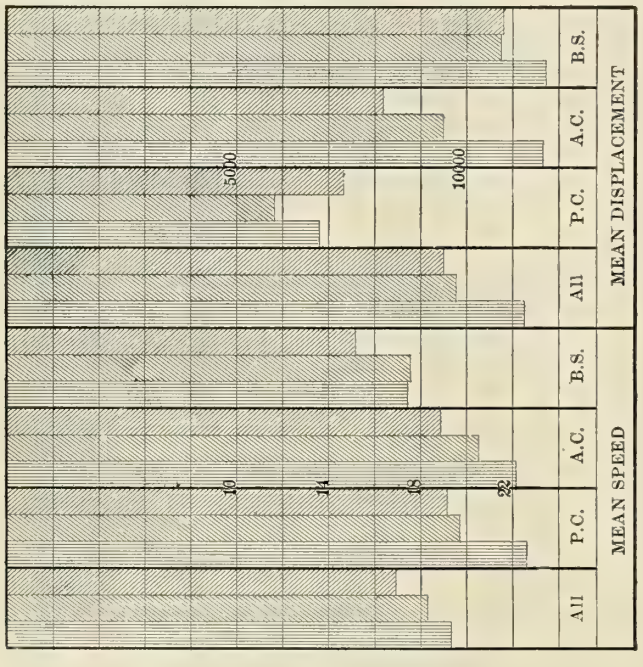
COMPARISON OF BATTLE FLEETS.

It is difficult to prophesy what the condition of affairs will be in 1919, which is the period when the navies of the two countries will be found definitely completed so far as the present programs of construction are concerned. Germany will possess in 1917, in accordance with the act above noticed, a very formidable array of ships, thoroughly modern, and consisting of thirty-eight battleships, fourteen armored cruisers and thirty-eight protected cruisers. If there is any change made in the German program care will certainly be taken to still further increase the power of the fleet to be provided. If France does not wish to be relegated from the point of view of naval power to the third rank, or perhaps even to the fourth or fifth, because the fleets of the United States and of Japan are increasing continuously, it is necessary for the country to make a great effort.

Editor's Note: In this connection, it will be of interest to see where the United States stands with regard to the two under comparison. With this idea in view Table IV has been compiled, showing the present strength of the American navy in the three classes of ships tabulated for the French and German navies. It will be seen at a glance that the battleship strength of the United States Navy as at present constituted falls very

TABLE IV.

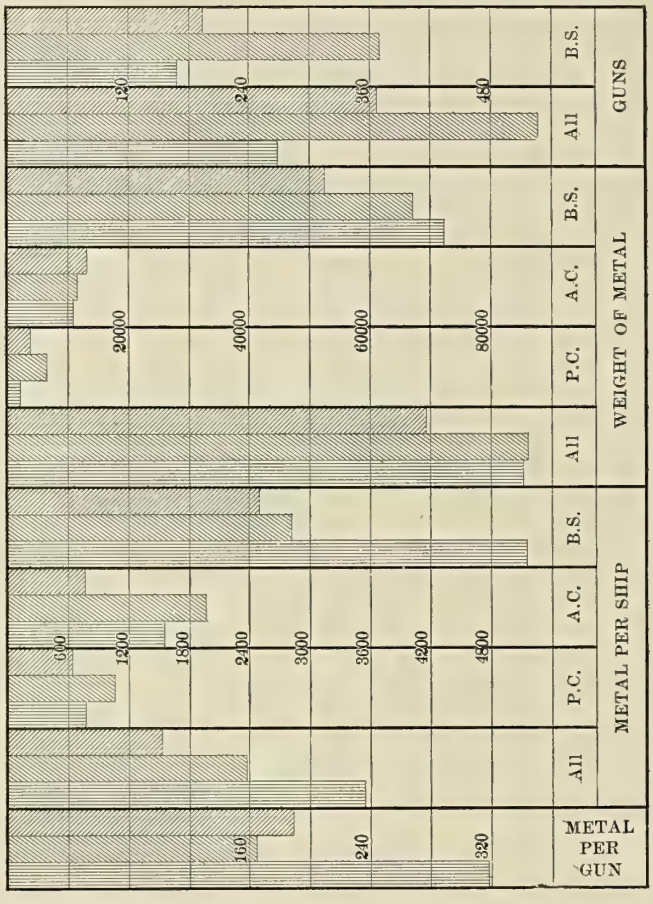
United States Battleships	Year	Tons	Speed	Battery Heavy	Mean	Light
Indiana, *Massachusetts*, *Oregon*	1893	10,288	16.2	12	4	26
Iowa	1896	11,346	17.1	12	6	24
Kentucky, *Kearsarge*	1898	11,520	16.9	8	14	28
Alabama, *Illinois*, *Wisconsin*	1898	11,552	17.2	4	14	22
Maine, *Missouri*, *Ohio*	1901	12,500	18.0	4	16	20
Rhode Island, *Virginia*	1904	14,948	19.0	12	12	32
Total	14	167,302	17.5	112	160	348
Armored Cruisers						
New York	1891	8,150	21.0	6	12	10
Brooklyn	1895	9,215	21.9	8	12	16
Charleston	1904	9,700	22.0		14	42
Colorado, *Maryland*, *Pennsylvania*, *West Virginia*	1903	13,680	22.3	4	14	38
Total	7	81,785	22.1	30	94	220
Protected Cruisers						
Olympia	1892	5,865	21.7	4	10	18
Columbia, *Minneapolis*	1892, 1893	7,350	22.9	1	10	15
Total	3	20,565	22.6	6	30	48



CHARACTERISTICS OF THE AVERAGE SHIP.

far short of that of either of the two European powers, and although the amount of construction now on hand in American yards is greater than in either of the other cases, and, indeed, is about equal to the two combined, yet the slowness of our construction discounts in very large measure the gross quantity of tonnage uncompleted.

When it comes to the question of armored cruisers, the American forces seem to be much stronger than the German, but



GUNFIRE OF THE SEVERAL CLASSES OF SHIPS.

very markedly weaker than the French; although our units are larger and faster than is the case with either the French or the German, and better armed than the French. In first class protected cruisers we are in a decided minority, having only three against six for each of the other navies.

Another table gives the whole situation in a nutshell as regards

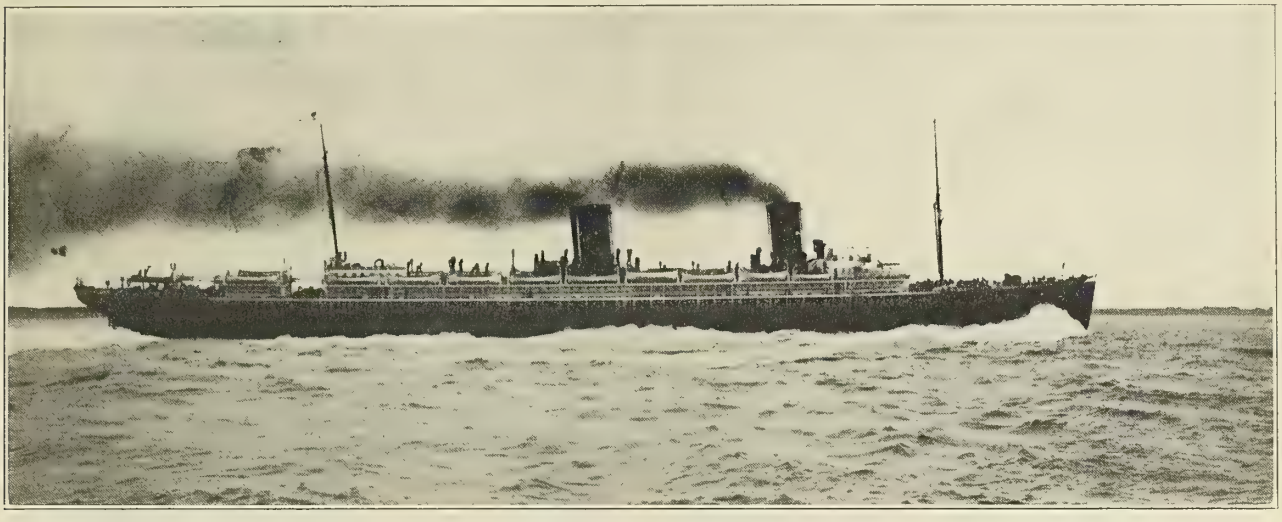
TABLE V.

		Ships	Tons	Guns	Average Tons	Sp'd	G'ns	Broadside —Mean— G'ns	Metal	Per ship	Per gun
France.	Battleships.	21	236,709	340	10,796	15.2	16.2	194	52,024	2,477	268
	Armored Cruisers.	18	147,049	230	8,169	18.8	12.8	131	13,366	743	102
	Protected Cruisers.	6	43,689	72	7,282	19.2	12.	40	3,786	631	95
	Total ...	45	427,447	642	9,499	16.9	14.3	365	69,176	1,537	189
Germany.	Battleships.	24	258,911	636	10,788	17.6	26.5	369	67,783	2,814	184
	Armored Cruisers.	6	56,921	152	9,487	20.5	25.3	87	11,770	1,962	133
	Protected Cruisers.	6	35,100	70	5,850	19.7	11.7	67	6,467	1,078	97
	Total ...	36	350,932	858	9,748	18.3	23.8	523	86,020	2,389	164
United States.	Battleships.	14	167.302	272	11,750	17.5	19.4	172	71,836	5,131	418
	Armored Cruisers.	7	81,785	124	11,684	22.1	17.7	75	10,902	1,557	145
	Protected Cruisers.	3	20,565	36	6,855	22.6	12.	21	2,256	752	107
	Total ...	24	269,652	432	11,236	19.3	18.	268	84,994	3,541	317

number of ships, total and average displacement, average speed and total and average number of guns, included under the headings of "heavy and mean." Under the heading "Broadside" are given figures covering the weight of metal which could be discharged in one round of the guns bearing on one side of the ship. The mean weight of these projectiles is also given. No gun smaller than the German 3.4-inch is included. The superiority of the American battleship is very marked. This table covers the three classes of ships for the three navies under consideration, and is supplemented by diagrams which give a graphic representation of the situation.

La Provence has six steel decks, named from the bottom: fourth, third, saloon, upper, promenade and upper promenade decks. The upper promenade deck aft contains the cafe and terrace cafe, with a seating capacity of 60 persons, decorated in pale green, style Directoire; while forward on this deck the chart house, captain's and officers' cabins and wireless cabin are located, 49 feet above the water line.

On the promenade deck are located two large suites of rooms, consisting of parlor, sleeping room and private bath, sumptously decorated in the style of Louis XVI; and connected with these suites are large family cabins capable of accommodating three



LA PROVENCE AT FULL SPEED ON TRIAL TRIP OFF BELLE ILE.

THE NEW FRENCH LINER LA PROVENCE.

This ship, which was partially described in our issue for August last, and the launching of which was illustrated in our issue for May, 1905, reached New York on her maiden voyage April 27. The principal dimensions, as given in August, show a length over all of 627 feet, a beam of 65 feet, a depth of 42 feet and a draft of 26 feet 9 inches. The corresponding displacement is 19,160 tons. The gross tonnage of the ship is 14,744; the under deck tonnage, 10,553; the net tonnage, 3,833.

Propulsion is by twin screws operated by triple expansion four cylinder engines of an aggregate of 30,000 horsepower, the trial speed having been somewhat less than twenty-three knots. Steam is supplied by twenty-one cylindrical boilers working at a pressure of 206 pounds per square inch, and fitted with the Howden system of forced draft. The coal consumption per day is given as 450 tons, while the bunkers have a total capacity for 4,400 tons.

The cylinder diameters are respectively 120, 194 and two of 242 centimeters, with a stroke of 170 centimeters. These figures correspond respectively to cylinder diameters of 47¼, 76½ and 95¾ inches, the stroke being 67 inches. The boilers have mean diameters of 17 feet 1 inch and 16 feet 1 inch in the two sizes, with a length of 10 feet 10 inches in each case. The aggregate grate surface is 1,570 square feet with heating surface 58,172 square feet, the ratio of the one to the other being 37 to 1.

On trial trip the speed reached was 22.7 knots, with an average of 22.3, at a draft of 26 feet 11 inches. The average coal consumption per indicated horsepower per hour figured out at about 600 grams, which is 1.32 pounds, a remarkably good performance. The maximum power developed was 30,625 indicated horsepower. The revolutions were 87 per minute.

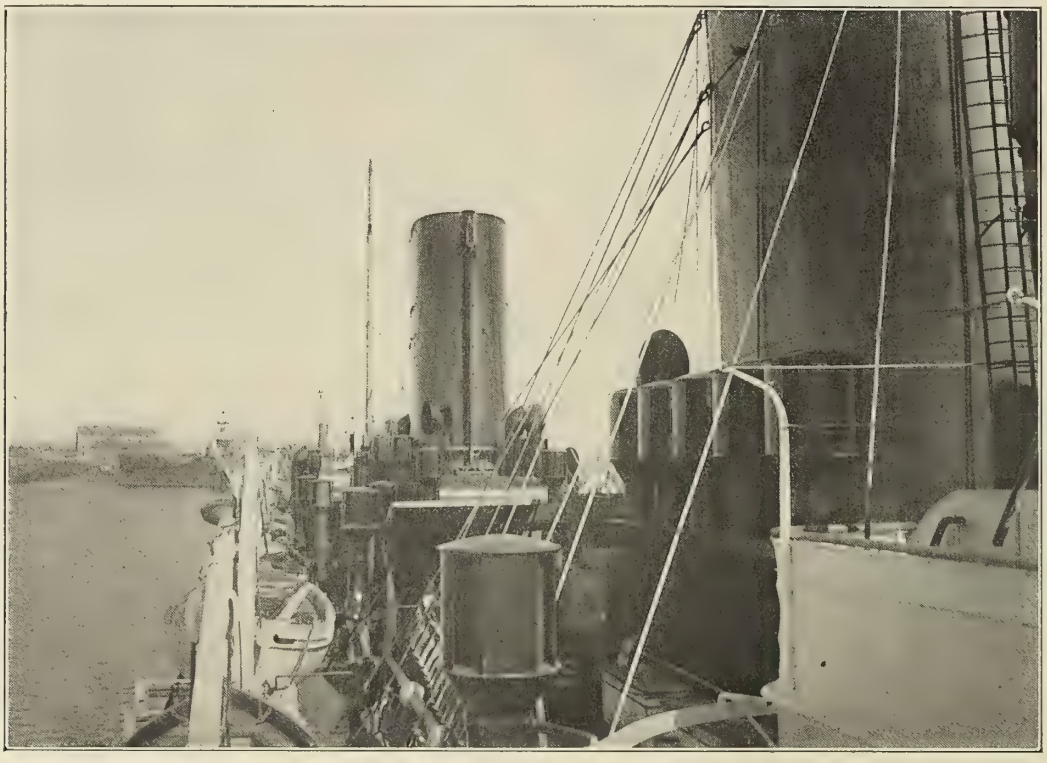
STARBOARD BOW, BATTLESHIP LIBERTE IN DISTANCE.

people if desired. In addition to this there are four immense cabins de luxe consisting of sitting room, parlor, bathroom and toilet, and all the suites are distinctive in decoration. No first-class room has more than three berths, while in many cases the lower berths are arranged as luxurious settees.

On this deck are also six single cabins de luxe without bath, nine large cabins de famille, together with eight large outside rooms and eight comfortable inside cabins. Here are also located the library and music room. All these apartments are heated by steam, lighted by electricity and provided with telephones, and in addition the suites, luxes, dining saloon, ladies' room and smoking room are supplied with electric fans and radiators.

Besides the portholes, numerous ventilators from deck, etc., a special system of piping along the ceilings of the cabins has been installed, thus insuring complete and perfect ventilation, which can be regulated at will.

The social hall of the first class is a splendid apartment, the walls being decorated in white with gold carvings, and the furnishings of the Louis XVI period. In place of the usual circular port holes are fitted large square windows, while a skylight in an artistic glass dome furnishes light throughout the day. At night illumination is furnished by electricity in luminous ceiling domes.



VIEW OF THE AWNING DECK, TAKEN FROM NAVIGATING BRIDGE.

TELEGRAPHS, STONE-LLOYD AND RUDDER INDICATORS, ON NAVIGATING BRIDGE.

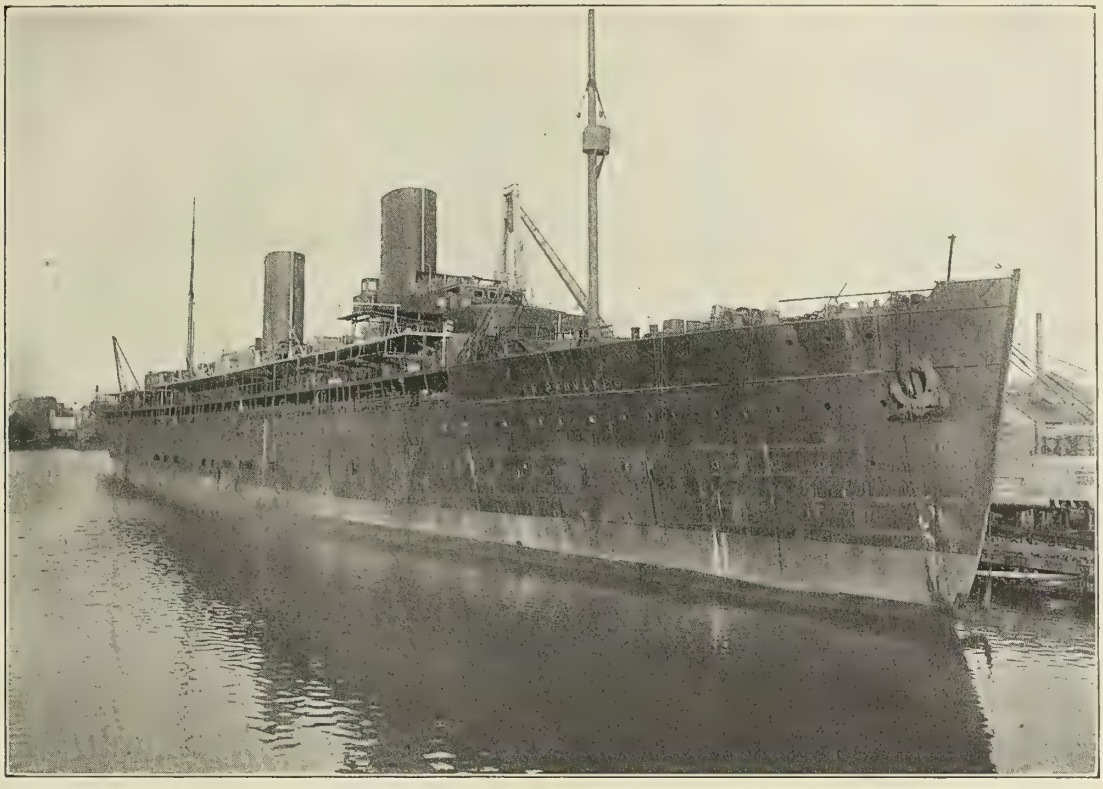
On the upper deck will be found the first-class smoking room finished in dark oak, luxuriously upholstered and decorated, style Renaissance, capable of seating comfortably at tables conveniently arranged 76 persons at a time.

The entrance of the main stairway leading from the promenade to the upper deck is finished in teak wood, elaborately carved; the skylight or dome is supported by an allegorical figure representing "La Provence," offering to the world the olive branch of peace, surrounded by young Tritons with garlands of fruits, flowers and shells, while beneath this allegorical figure is a large plate glass mirror, on each side of which are paintings after the style of the masters of the eighteenth century, and suspended over the paintings are lights in the shape of lanterns, after the Versailles style.

From the main entrance on the upper deck we enter the spacious first-class dining saloon, 65 feet in length and 45 feet in width, located amidships, between the two funnels, with a seating capacity of 250 passengers at a time. This is practically a reproduction of the dining room in the Duke of Subise palace in Paris, decorated in light green, the fireplace surmounted by the figure Amphitrite, the goddess of the sea, seated on a float filled with flowers. There are twenty-six dining tables, with ample chair space, bronze candelabra of the style of Louis XV, vases filled with natural flowers, and everything arranged with an eye to real comfort.

On the saloon deck are fifty-six large outside cabins, steam heated, lighted by electricity, provided with telephones, and every comfort and convenience that can be devised for the regular traveler. In addition to this there are seventy-two comfortable, well-ventilated inside cabins. On this deck we have the office of the chief steward; the ladies' boudoir, decorated in light blue and gold style of Louis XVI; the children's dining saloon, and the hair

dressing parlor. A manicurist, also a stenographer, will be at the disposition of those passengers requiring such service during the voyage. A regular daily newspaper will be published on board, containing all wireless news received from shore, entertainment notices, etc.



LA PROVENCE UNDERGOING COMPLETION IN BUILDER'S YARD.

Another unique feature in the ship is the installation of an elevator running from the saloon deck to the upper promenade deck, operated by electricity and located on the starboard side of the main entrance.

The second-class accommodations, providing for 204 persons, and consisting of twenty-seven outside and thirty inside rooms, some with two and some with four berths, are located on the after portion of the main deck; with the dining room on after portion of upper deck, and smoking room and ladies parlor on after portion of promenade deck.

Roomy quarters have been provided for the accommodation of 1,000 third-class passengers, with special compartments for families and single ladies, and a special shower bathroom installed for their use.

The safety of the ship is assured by means of an elaborate outfit of watertight doors on the Stone-Lloyd system. Steering is by the Brown hydraulic steering gear with electric control. Twenty steel lifeboats and six life rafts are installed, any of which can be lowered by the quadrant davit system in forty seconds, there being four men employed for each boat.

The double bottom is divided into ten watertight compartments, capable of holding a total of 1,770 tons of water ballast. The hull proper is divided into twenty separate watertight compartments by means of nineteen watertight bulkheads.

The maiden voyage from Havre occupied 6 days 9 hours and 10 minutes, which is a new record for the distance between these ports, the previous record of 6 days 9 hours and 20 minutes having been made last year by *La Lorraine*. The mean speed for the 3,201 nautical miles figures out at 20.9 knots, which will, of course, be much better when the engines get shaken down into smoother running order. As it was, however, they ran very smoothly, passengers reporting that there was almost no vibration from either engines or propellers, even during the heavy weather of the third day. The daily runs are given as 593, 537, 484, 508, 519 and 560 nautical miles. The daily speeds figure out respectively at 21.4, 21.65, 19.5, 20.5, 20.9 and 21.5 knots. On the return voyage the time was 6 days, 7 hours, thus lowering the previous record of 6 days, 8 hours, 45 minutes, held by *La Savoie*. This is a creditable performance for a new steamer, and is one to which the builders and company can look with much satisfaction.

The crew consists of a total of 435, there being 10 officers and 46 sailors in the deck department; 15 officers and 251 men in the engineering department, and 113 in the stewards' department.

AWNING DECK, SHOWING "QUADRANT" DAVITS.

The keel of the ship was laid December 1, 1903; she was launched March 21, 1905; had her trial trip March 13, 1906, and sailed on her maiden voyage April 21, 1906.

LENGTHENING OF THE STEAMER HAMILTON.

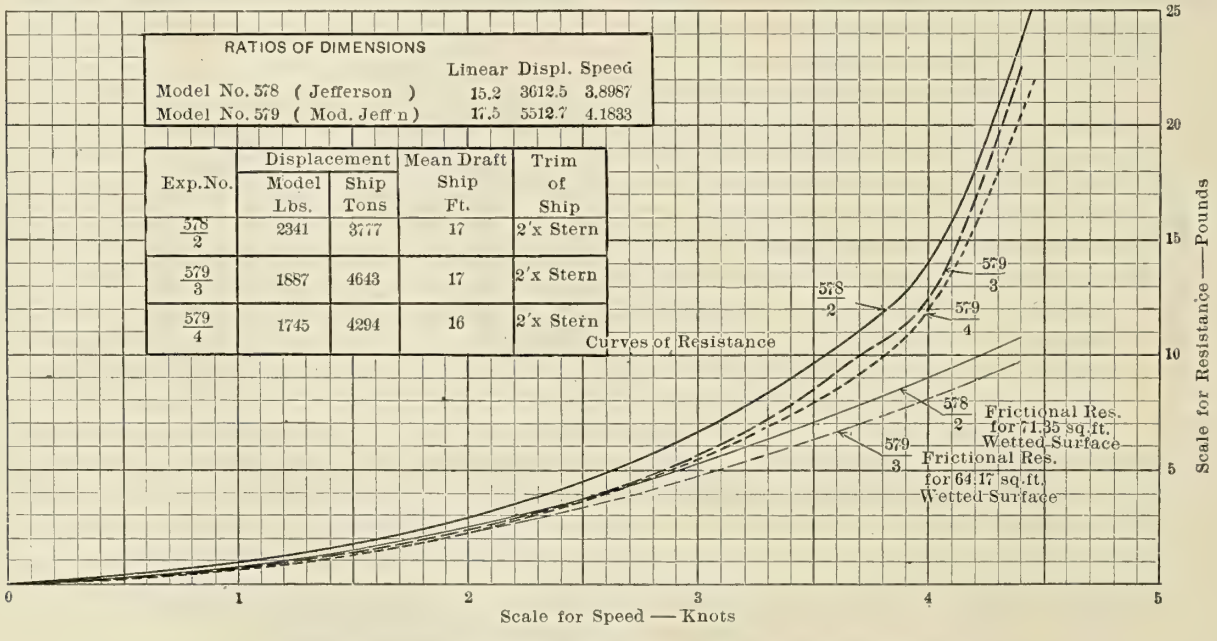
BY ALEXANDER WILLS.

The history of the Old Dominion Steamship Company, which is one of the most prominent lines on the Atlantic Coast, and provides a daily passenger and freight service between New York and the Virginian ports of Norfolk and Newport News, is an index of the growth of the shipping between these ports. The management of the above company is alive to all interests of its patrons, this fact being demonstrated by the service afforded, the vessels of their main line being in speed, passenger accommodations, etc., the equals of any engaged in the coastwise trade, as well as being equipped for the carrying of the large amount of freight handled between the two ports.

The present main line fleet consists of the steamers *Monroe*, *Hamilton*, *Jefferson*, *Princess Anne* and *Jamestown*, all of which have a speed of from 15 to 15½ knots. Of the above, the *Monroe* is the largest and latest, and was fully described in our August, 1903, number. The *Hamilton* and *Jefferson* are sister ships, the *Princess Anne* is the same size as these two vessels, and the *Jamestown* is somewhat smaller, being the reserve boat of the fleet.

THE STEAMER HAMILTON BEFORE BEING LENGTHENED.

To meet the large increase in the amount of freight to be handled, the company has recently had the *Hamilton* lengthened, this means of caring for the increased traffic having been adopted in order to give an increased daily movement, freedom from congestion at terminals, and to avoid interference with the sailing schedule, which would result if the additional freight capacity had been provided in another vessel.

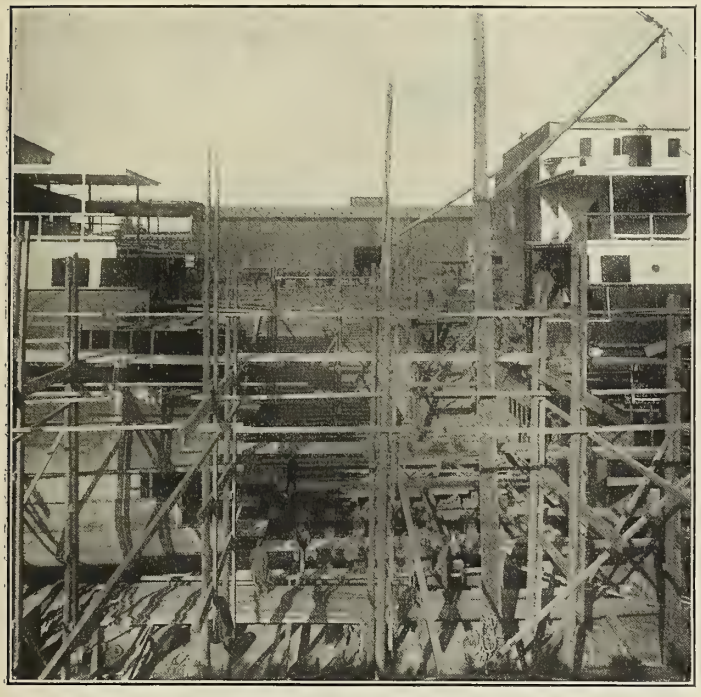


CURVES OF RESISTANCE OF JEFFERSON MODEL, BEFORE AND AFTER LENGTHENING.

The *Hamilton* is a single screw steel steamer of the hurricane

deck type, built by the Delaware River Iron Shipbuilding Company (Roach's yard), at Chester in 1899, and before lengthening was of the following dimensions:

Length aft side of stem to fore side of stern post	304 feet.		
Beam molded	42 feet	Gross Tonnage	3129
Depth to Main Deck	27 "	Net "	2026



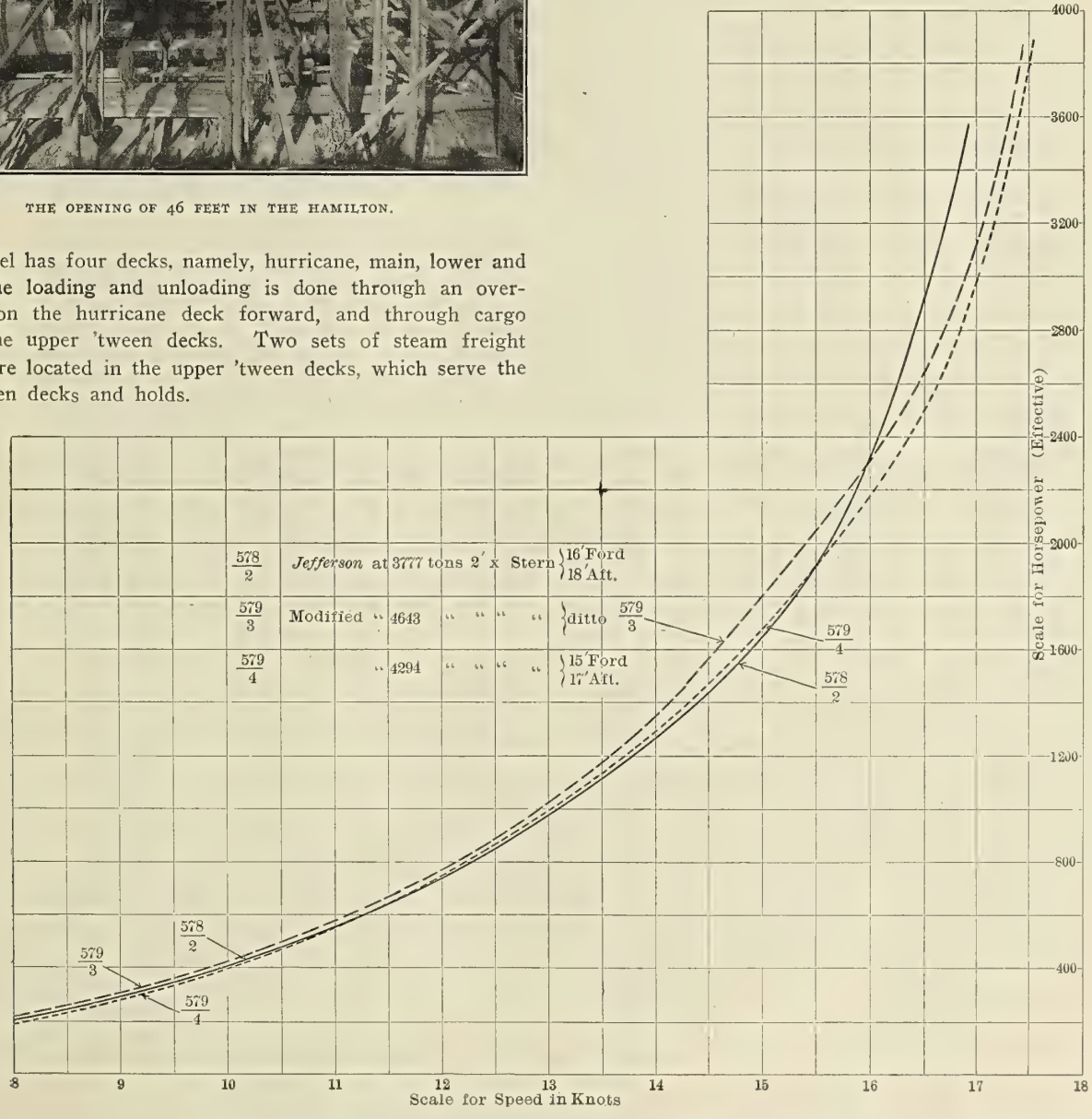
THE OPENING OF 46 FEET IN THE HAMILTON.

The vessel has four decks, namely, hurricane, main, lower and orlop. The loading and unloading is done through an over-all hatch on the hurricane deck forward, and through cargo ports in the upper 'tween decks. Two sets of steam freight elevators are located in the upper 'tween decks, which serve the lower 'tween decks and holds.

Accommodations for first-class passengers are provided on the main deck aft of the machinery casings, and in a deck house on the hurricane deck extending from the over-all hatch to within about 30 feet of the stern. The pilot house, officers' quarters, and first-class smoking room are located on the shade deck, which extends from the over-all hatch aft.

The first-class dining saloon is located on the main deck directly aft of the engine casing, with the main stairway at its after end leading to the social hall on the hurricane deck. The galley is on the main deck between the boiler and engine casing, and the pantry is abreast of the engine casing on the port side. The officers' mess room is on the hurricane deck over the galley. Quarters for the crew and accommodations for steerage passengers are on the main deck forward.

The machinery consists of a triple expansion engine with cylinders 27, 44½ and 73 inches in diameter by 54 inches stroke, and four Scotch boilers 14 feet 3 inches diameter by 12 feet 7 inches long. All cylinders are fitted with piston valves worked by Marshall valve gear. The boilers were built for a working steam pressure of 190 pounds, and have each three furnaces of 46 inches inside diameter, the total grate surface being 293 square feet and the heating surface 9,905 square feet (ratio 33.8 to 1). The condenser forms part of the engine framing,



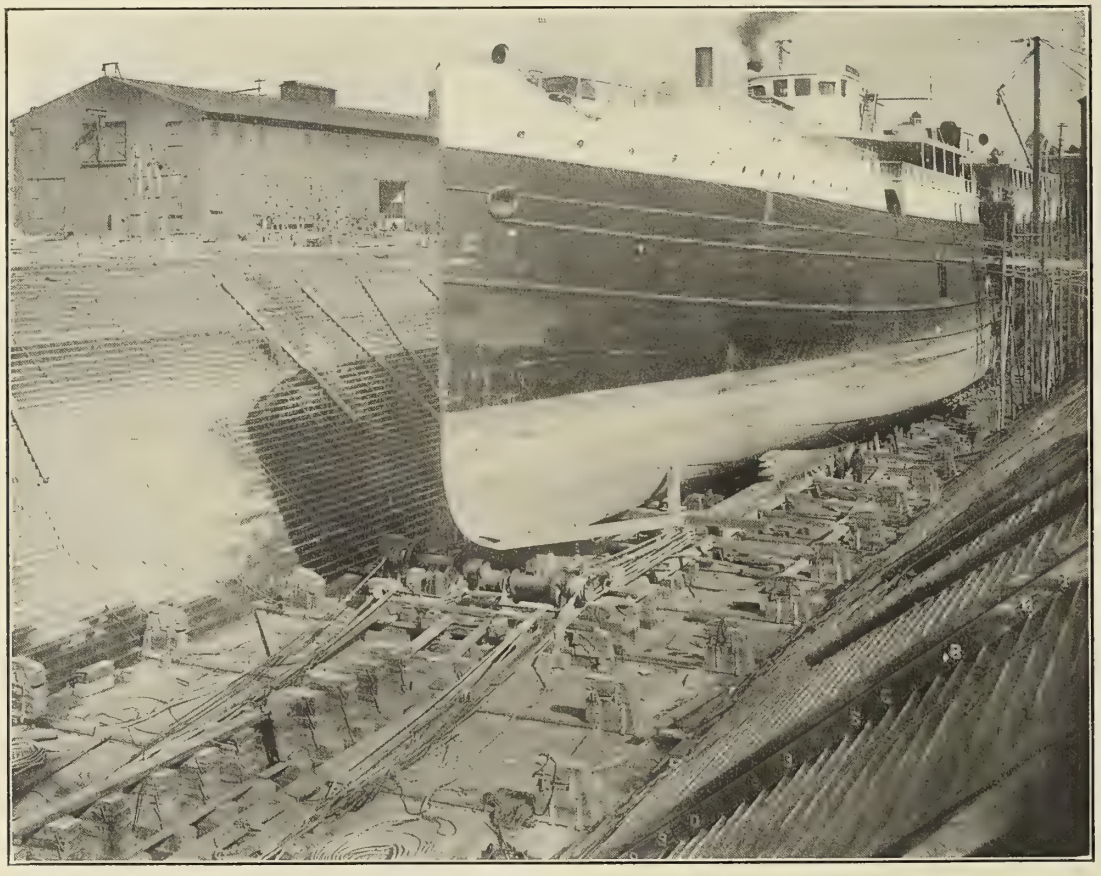
POWER-SPEED CURVES FOR ORIGINAL SHIP AND LENGTHENED SHIP.

and has 6,100 square feet of cooling surface. The air pump is worked from the main engine. Under average conditions the main engine gives about 3,000 indicated horsepower.

After the decision to lengthen the vessel had been reached, the amount to be added was one of the first things to be considered. Within certain limits this length had to be governed by the length of piers at the terminals, and the location of the cargo ports, relative to the pier gangways. These conditions decided the owners to adopt an added length of 46 feet. This question having been settled, the effect of the increase in dimensions on the power and speed of the vessel was investigated. Models of the original and lengthened vessel were towed in the United States experimental model basin in Washington, at different drafts and speeds, to determine the effective horsepower required. The results of the experiments are indicated on the accompanying curves. These curves show that for speeds under 16 knots at the mean draft of 17 feet, somewhat more power was required to drive the lengthened vessel, but that for speeds beyond 16 knots, the lengthened vessel required less power than the original. For the same draft there is a difference of 866 tons in displacement, so that while the effective horsepower per ton of displacement at 15 knots was 0.436 for the original vessel, it was only 0.3875 for the lengthened vessel, a decrease of over 11 percent.

With the original vessel at 17 feet mean draft and the lengthened vessel at 16 feet mean draft, the curves of effective horsepower follow each other very closely and cross at 15.1 knots. With these drafts, the difference in displacement is 517 tons in favor of the lengthened vessel, and the effective horsepower required per ton of displacement at 15½ knots is 12.1 percent less. The increase in power required to drive the lengthened vessel over that required for the original at the same draft as shown by the model experiment was not considered enough to warrant any increase in the size of machinery, and no changes were made.

The contract for lengthening the *Hamilton* was awarded to the Newport News Shipbuilding and Dry Dock Company, and the vessel arrived at the builders' yard on January 13, 1906. The most desirable point to cut the vessel had been previously determined to be at the after boiler room bulkhead, and as the location of the machinery relative to its distance from the stern was not to be altered, it was necessary to remove the boilers from the ship. The vessel was put under the sheer legs, the piping in boiler room disconnected, and the boilers, uptakes and stack removed from the ship, also the boiler casing and other interior work involved in the alterations. A set of sliding and ground ways had, in the meantime, been placed in the dock, and on January 26 the vessel was floated into dry dock, stern first, to the desired position over the ways, and the dock emptied. The work of cutting and the preparations for pulling the sections apart were carried on simultaneously and on February 3, everything having been prepared, the sections were pulled part successfully in sixteen minutes after power was applied.



ARRANGEMENT OF TACKLE TO SEPARATE ENDS OF VESSEL.

The apparatus adopted to pull the sections apart is shown on the accompanying photographs. The ground and sliding ways were placed in position with a declivity of 6 inches in 200 feet, the ground ways used being the regular launching ways, with dimensions of 36 by 15 inches. They were supported about 21 inches from the bottom of the dock, and were about 19 feet apart on the outboard sides. The sliding ways were 26 by 14 inches, and at their outer ends were fastened together, and shores placed between the cross ties and clips bolted on the shell From the cross tie a shore was fitted on each side to clips bolted on the stem, the object of these shores being to prevent movement of the sliding ways without a corresponding movement of the vessel. To support the end of the vessel under the forefoot a 14-inch sliding way was used under the keel.

The tackle used in pulling consisted of two sets of four-fold 7-inch manila purchase on each side, fastened to the ends of the

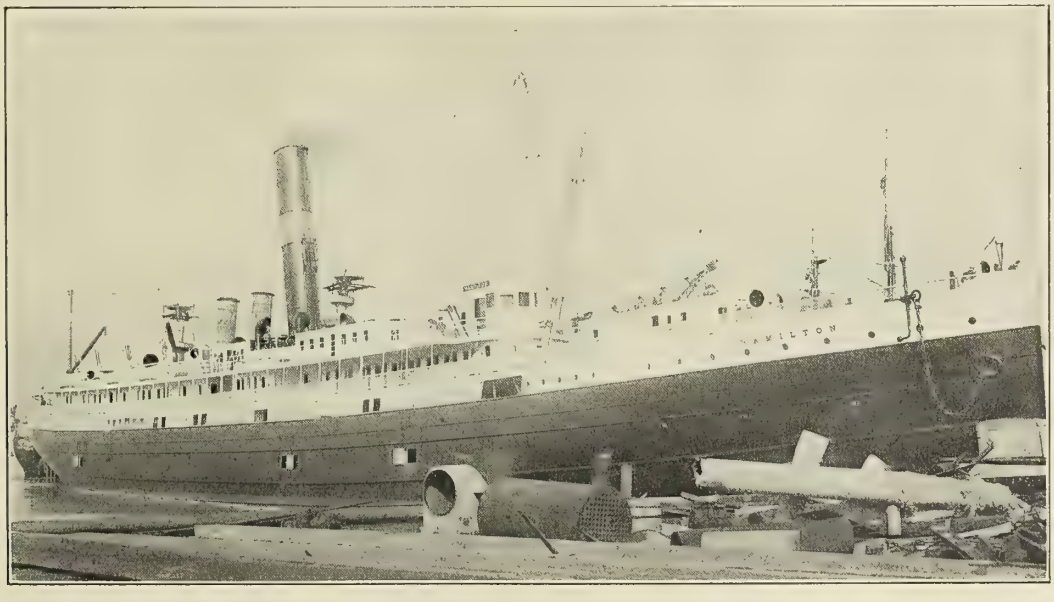
sliding ways and to the bottom of the dock. Two 35-horse-power electric winches were fastened to the ground ways to supply the necessary power, and two 100-ton hydraulic jacks were

THE LENGTHENED HAMILTON BEING FLOATED OUT OF DRY DOCK.

provided to help the start. The pull was directly on the sliding ways, and after power was applied, the sections separated readily, the forward end being pulled away evenly without a hitch, to the stop provided on the ways.

The new material used in the lengthening of the *Hamilton* was handled by derricks set in the dock on each side of the vessel, as shown on accompanying cuts. The new frames, floor plates, etc., had been furnaced previous to the cutting of the vessel, and by the time the sections were pulled part they were all ready to put in place. On March 12 all external steel work was completed, and the vessel was floated out of the dock and put under the sheer legs to have her boilers and mast re-installed, the latter having been removed to be shortened. On April 14 all work had been completed, and the vessel left the ship yard to resume her regular run.

The alterations in the *Hamilton* were carried out under the survey of the American Bureau of Shipping, and the United States Standard, and the vessel now is as strong as originally. The new framing is of a somewhat greater section than the old, the new floor plates are parallel to the base line, thus making them deeper at the bilge than the old ones, and new belt frames and an additional watertight bulkhead were added. The main deck sheer strake was doubled for a length of 188 feet



THE HAMILTON, AS LENGTHENED AND RECONSTRUCTED.

with 25-pound plates, and 22½-pound plate doubling was added to the bilge strake for a length of 204 feet.

In order to provide additional cargo handling facilities for the increased 31 percent in the cargo space, an additional cargo port was fitted on each side forward of the boiler casing, between the lower and main decks, and an additional pair of cargo gangways was fitted between the main and hurricane decks. The space formerly occupied by the boilers is now used for freight, and two hatches side by side were provided in the main, lower and orlop decks, and independent freight elevators fitted in them. The engines for these elevators are placed on the lower deck, the elevators in general being similar to those on the steamer *Monroe*. At these new hatches on the main deck a hoisting engine and two cargo cranes were fitted.

Extensive additions were also made to the passenger accommodations. In the additional length provided on the hurricane deck new staterooms were fitted, and new stairways added for access from the hurricane deck to the main deck and to the first-class smoking room on the shade deck. The old smoking room located aft of the boiler casing on the shade deck was divided and made into a dining saloon and smoking room for intermediate passengers. On the shade deck forward of the boiler casing a new and larger first-class smoking room was built and fitted with toilet and buffet. No changes were made in the passenger accommodations on the main deck, but the galley and pantry were considerably increased. The passage at the side of the pantry was dispensed with, and the pantry extended to the ship's side. The galley was also widened about 8 feet, all dressers and wood work renewed, dumb waiter increased and new galley floor fitted. Other changes on the main deck consisted in fitting a baggage room abreast of the boiler casing, and changing the location of the baggage ports. The dynamo room abreast of the engine casing was increased in size, and the electric plant increased from one 20-kw and one 4-kw generating sets to one 25-kw and one 20-kw sets, thus materially increasing the lighting capacity.

While the above alterations were being made to the hull, extensive repairs were also made to the machinery. The main engine was completely overhauled and a new high pressure valve stem fitted, the top section of condenser re-tubed, and a new tail shaft fitted. A Reilly feed-water heater was also fitted in the engine room.

The four main boilers were entirely overhauled and new middle furnaces fitted in each one. An entire new smokestack was fitted. Two 54-inch Sturtevant fans were placed in the upper part of the fidley, with suctions from the top of the fidley and from the cargo space between decks. These fans serve to cause a circulation of air in 'tween decks, and also to ventilate the fire-room, as well as to assist the draught.

In addition to all the repairs and alterations, the vessel was thoroughly cleaned and re-painted throughout, so that now she is practically a new ship.

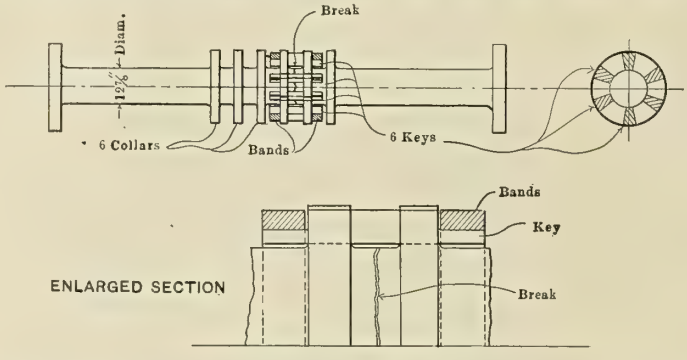
The following table gives some interesting figures relative to the percentage of increased cargo capacity and passenger accommodations obtained by the lengthening of the vessel:

	Original	Lengthened	Percent Increase
Freight space (in terms of cubic feet)	163,400	213,400	31
Freight ports	6	10	67
" hatches	5	6	20
" ports and hatches square feet	793	1,174	48
Cubic feet of freight per square foot hatches and ports	206	182 (—)	12
Freight hoisters	4	6	50
" elevators	4	6	50
First-class state rooms	53	62	17
First-class W. C's. for men	5	6	20
" " W. C's. for women	4	6	50
" " smoking room square feet	241	510	112
First-class galley square feet	198	290	47
" " pantry " "	180	300	67
Passenger exit forward	—	1	—
Intermediate staterooms	5	6	20
" dining saloon square feet	—	165	—
Intermediate smoking room square feet	—	88	—

Repair of a Thrust Shaft at Sea.

On February 21, in latitude 32° 27′ north, longitude 38° 44′ west, during a heavy gale and head sea, the Spanish single screw steamship *Ida* of Bilboa, Captain Arano, en route from Liverpool for Cuba with cargo and passengers, sustained a breakage of the thrust shaft between the second and third collars, the after portion being drawn away from the forward end 1⅛ inches. It was found that the after horseshoe collar had also broken, and of course the ship was entirely unable to proceed without some sort of repairs. During the three days in which she was laid to, the engine room staff effected temporary repairs in order to enable the ship to cover the distance of 1,240 miles to Bermuda, which place was reached March 10.

The method of making these repairs was very ingenious. It consisted in cutting six slots in two collars, one each side of the break, the slots being spaced sixty degrees around the circumference, and measuring 1½ inches wide and 2¼ inches deep.



They were then filled with keys forged and fitted to place, the keys being held in place by two bands or rings around the shaft measuring 2½ inches wide and ¾ inch thick. In addition to this, two holes were drilled diametrically across the shaft at the break, and pins were driven in in order to ease the shearing stress upon the keys. These repairs permitted the ship to make slow speed ahead, but she could not steam astern because, on account of the displacement of the shaft axially, no horseshoe collar could be fitted aft of the break, and hence no thrust could be permitted on the forward side of the propeller, as this would have resulted in pulling the sections of the shaft entirely apart.

Great credit is due the engineering staff of the ship for the way in which repairs were made, the more so on account of the difficulties which they had to encounter. They had no proper material from which to make keys, and had to use tube stopper rods, which they proceeded to cut up and weld together to obtain the requisite dimensions for the keys.

The *Ida* was built by J. Laing of Sunderland, England, in 1890, to the order of the Linea de Vapores Serra, and measures 1,805 tons net and 3,091 tons gross. She is constructed of steel and measures 340 feet in length, with a beam of 41 feet 1 inch and depth of 26 feet 3 inches. There is a bridge house 78 feet in length and a forecastle with a length of 34 feet. The triple expansion engine has cylinders 24½, 40 and 66 inches in diameter, with a stroke of 45 inches.

W. B. Smith.

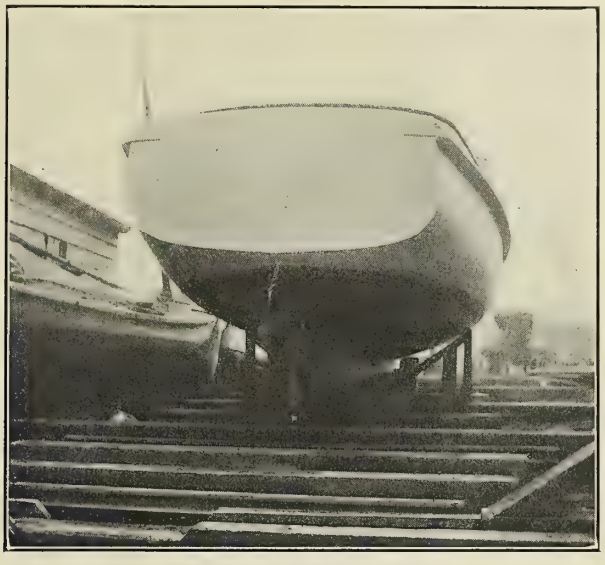
A FORTY-FOOT CRUISING LAUNCH.

BY JOHN Q. WALTON.

A forty-foot cruising launch has just been completed and launched from the shop of Captain Reagan, at Washington, D. C. The general dimensions are as follows: Length, 40 feet; beam, 10 feet 6 inches; freeboard at bow, 53 inches; freeboard at stern, 34 inches; draft at wheel, 3 feet 1 inch; headroom in cabin, 6 feet 1½ inches, from top of floor to under side of carline.

The berths or locker tops are of extra width and very comfortable, being covered with double thick cushions. The space under the cushions is fitted with drawers, so that it is very convenient in getting anything out of the lockers. The cabin trunk and inside finish are of cypress, the outside and the cockpit of white pine, and the cockpit rail, or capping, of black walnut, bright.

The cockpit is large and exceptionally roomy; it is fitted with two seat lockers, one on each side, and two doors in after end to permit getting at the space under after deck. The cockpit deck is of cedar, 1⅜ inches thick, finished bright, is watertight and self-bailing. There is ample room for a few camp chairs, making it a very comfortable place in good weather, as it is cov-



STERN VIEW OF BELLROSE.

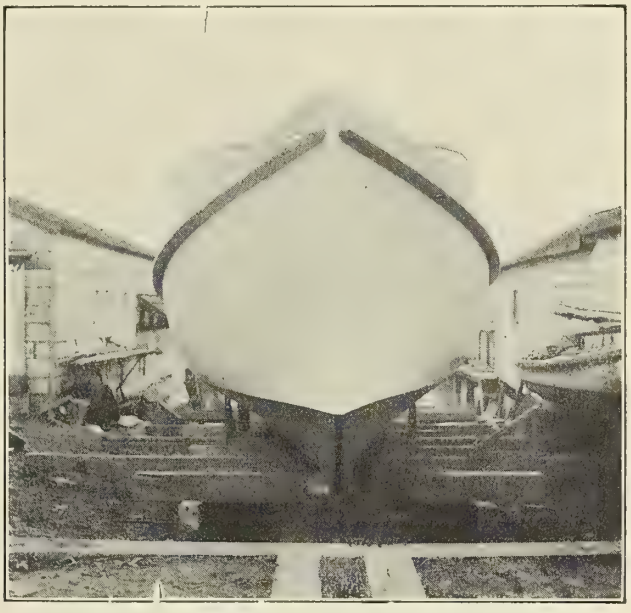
ered with a standing awning, extending over the companionway slide on house. The main deck is of cedar, 1⅜ inches thick, calked and painted; the plank sheer, sheer strake, clamps and bilge stringers are of yellow pine, each in one length, 1⅜ inches thick. The slides, companionway and companionway doors, are of selected white oak, and finished bright, the doors being paneled. The cabin roof is covered with No. 10 duck and thoroughly painted.

The planking is of white cedar, 1⅜ inches thick; the keel, stem, sternpost, deadwood, frames and floors are of selected white oak, the keel is 3½ inches sided, the stem 4½ inches sided, the deadwood 3½ inches sided, the shaft log and stern post 5 inches sided, and worked to shape. The frames are steam bent, 1½ inches sided, molded at keel 2½ inches, and 1½ inches at head. The floors are of white oak, well fastened to frames and keel. The deck frame is of yellow pine, as shown in illustration.

At the forward corners of house are fitted hackmatack knees 3 feet long on clamp and 2 feet long on beam, by 4 inches sided, cut out in the throat to the curve of the house and thoroughly secured to clamps and beam; at the after end of cabin there are two hackmatack knees, extending 3 feet on beam and up on frame to the clamps; they are thoroughly secured to beam (cockpit beam) and frame; these knees are 2 inches sided.

At the forward end of cabin is fitted a bulkhead having a door in center. The space between this bulkhead and forward end of house is divided into galley and pantry, the galley being on the starboard side and the pantry on the port side. The pantry is fitted with dish racks, provision locker, and sideboard; a locker is located in the lower part of galley, for cooking utensils. Just forward of this space in the fore peak is located the ice box, which holds 200 pounds of ice; forward of ice box is the chain locker. Above the ice box, against the side of boat and under the deck beams, are secured two galvanized iron tanks for holding fresh water. They are filled through the hatch in forward deck, pipes being arranged for this purpose. These tanks are piped to the galley and pantry, and to the wash basin in toilet room aft.

The cabin table is formed by two turned stanchions fitted from floor to carlines at top of house, and a capping secured to these, the table leaves being hinged to this capping; the capping is 5½ inches wide, so that very little room is taken up when the leaves are dropped. In the after end of cabin, starboard side, is fitted a clothes locker with sliding door. As this space is out of the way and could not be economically used in cabin, it was



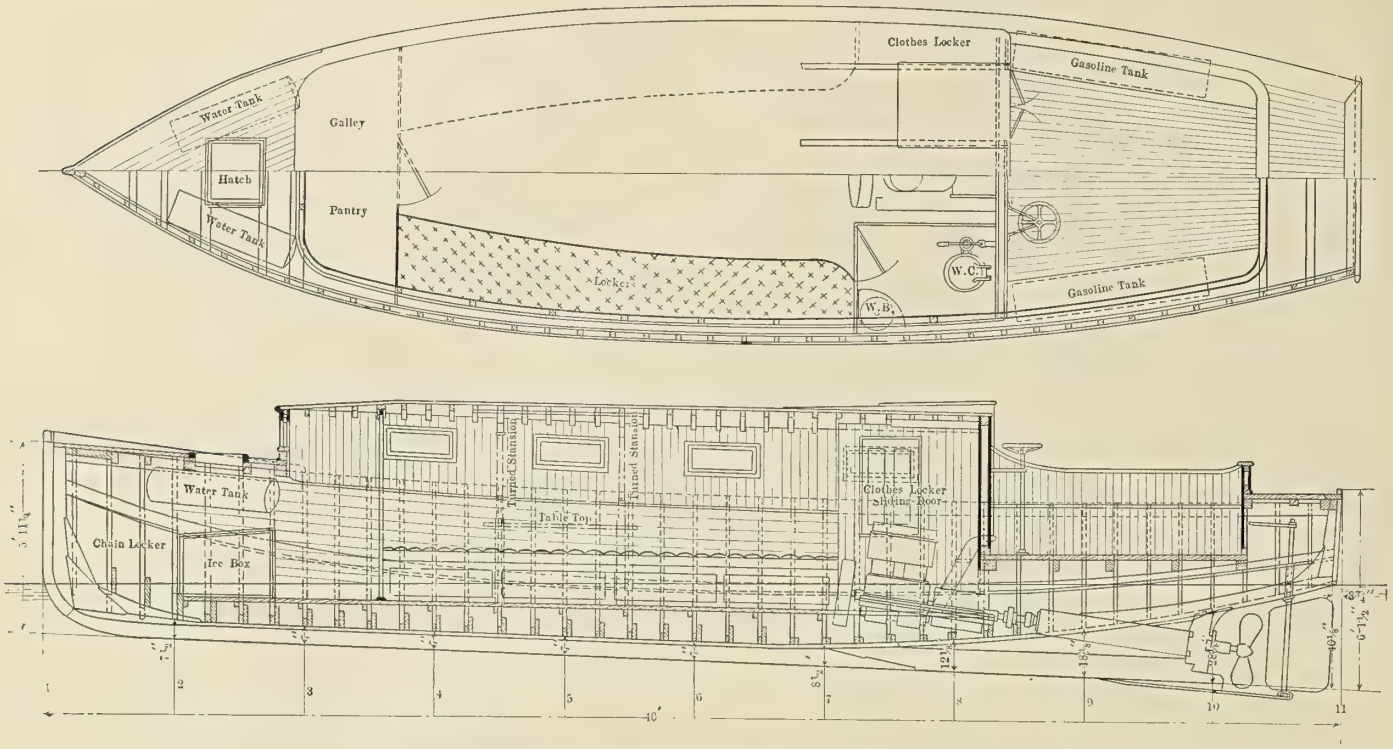
BOW VIEW OF NEW CRUISING LAUNCH.

formed into a locker, and is very roomy and conveniently located, and not in the way of anything.

On the port side of cabin, aft, is located the toilet room, fitted with a pump closet and stationary wash basin with running water. The fore and aft bulkhead has a portable shutter fitted in the lower part, so that it can be removed, if necessary, in overhauling engine. The engine foundation is made of white oak, the athwartship and fore and aft pieces being mortised and bolted together and thoroughly secured to boat.

Under the after end of cockpit floor is located a galvanized iron tank, placed athwartship; this tank is used for storing air for blowing the whistle; it is connected by piping to the air pump on engine, and to whistle on after end of house.

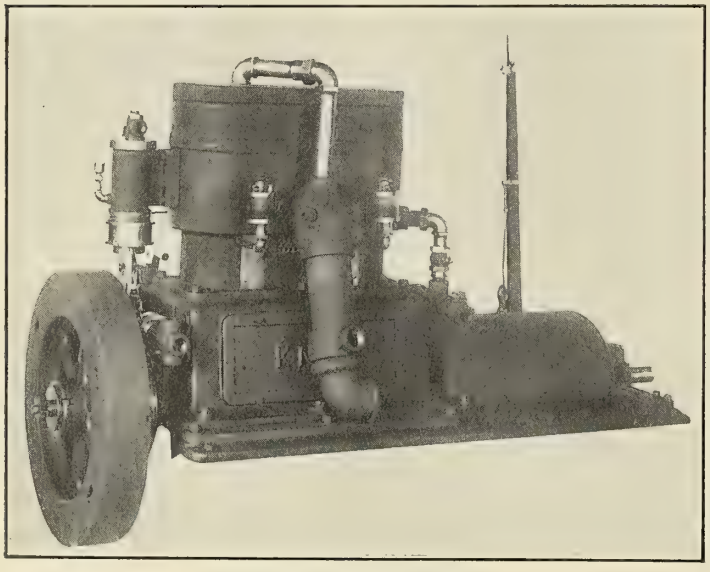
The boat is lighted by electricity from storage batteries, four batteries being placed under the cockpit deck and connected to the dynamo on the port side of engine just aft of flywheel. The dynamo is driven by belt from the engine, and the batteries are charged while the engine is running, so that they are always ready when wanted, whether the engine is running or not. There are five lights in the cabin, two on each side and one in the center between carlines, placed in a ceiling fixture. There is one light in toilet room, two lights in galley and pantry, one light in fore peak over ice box, and one portable for working



ACCOMMODATION PLAN AND INBOARD PROFILE OF 40-FOOT LAUNCH.

around engine. These batteries are also connected to the spark plugs of engine for ignition purposes.

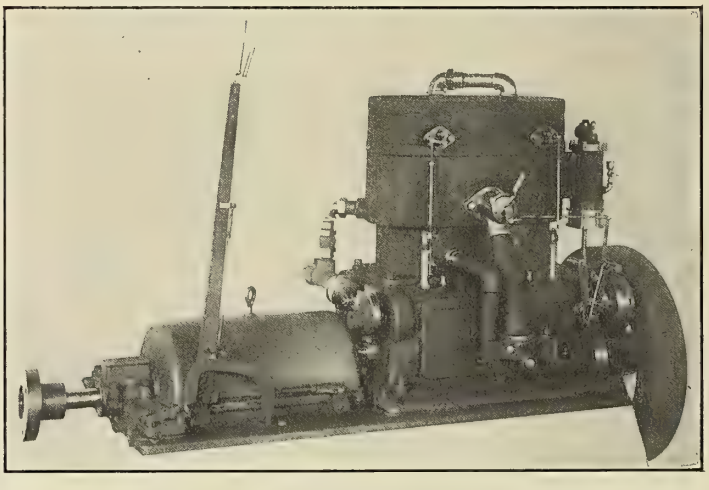
The gasoline tanks are located under seat lockers in cockpit. They are ceiled up so that no water can get into this space from cockpit. There are two tanks of copper, one on each side, connected by piping to each other and to the carburetor, and provided with valves, filling and vent pipes. In this way the gasoline is stored outside of the cabin or boat proper.



VIEW OF ENGINE FROM PORT SIDE.

The steering gear is of the automobile type, having a worm and quadrant with lever and chain to equalizing arm on tiller. The steering wheel shaft is vertical, and on port side in cockpit, as shown. A windlass is fitted on the forward deck; bow and anchor chocks are also fitted to this deck. Two anchors, one weighing 60 pounds and one 125 pounds with ⅜-inch chain, are carried. The running lights are oil burners.

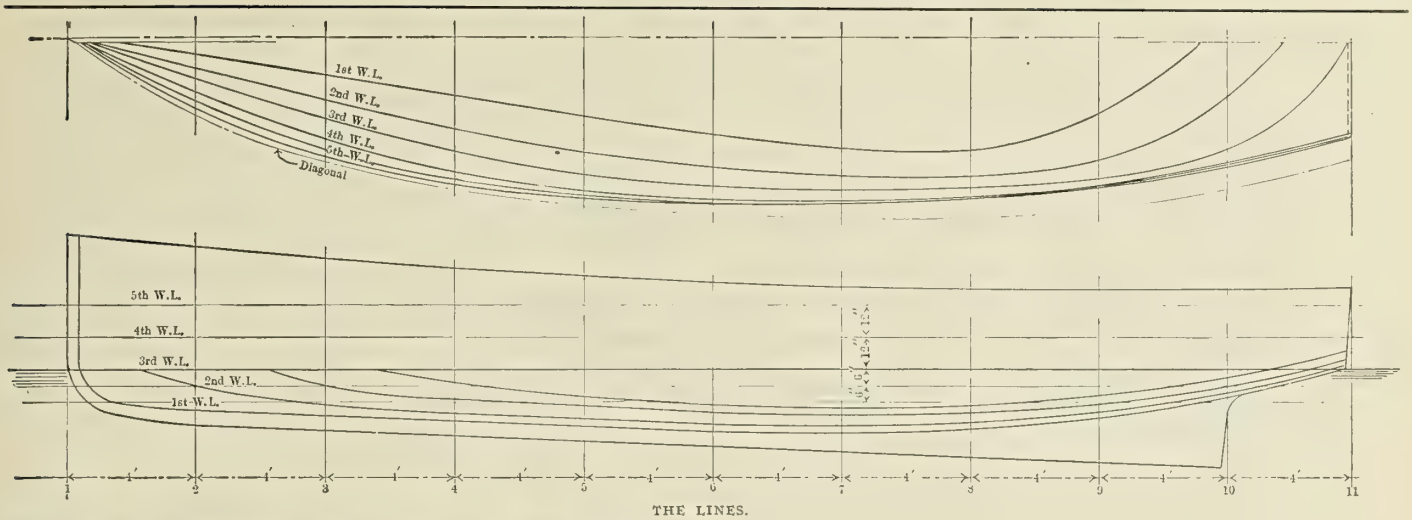
The motive power consists of a Knox two-cylinder, four-cycle, vertical gasoline engine of 20 horsepower, with cylinders of 6½ inches diameter and stroke of 7½ inches; it is fitted with a clutch and a three-bladed bronze wheel, 28 inches in diameter. The propeller shaft is of bronze, 1¾ inches diameter, passing through the shaft log, which is lined with a lead sleeve and fitted with a stuffing-box on the inboard end. The engine is fitted with a circulating pump, a bilge pump and an air pump, all of the plunger type and single-acting. The ignition is of the make and break type. A governor is fitted so as to keep the engine from racing when the clutch is thrown out, which is an excellent thing



STARBOARD VIEW OF PROPELLING ENGINE.

in making a landing. The reversing lever is at the companionway door, so that it can be handled from the cockpit; in this way the boat can be operated by one person, who can steer and handle the engine at the same time.

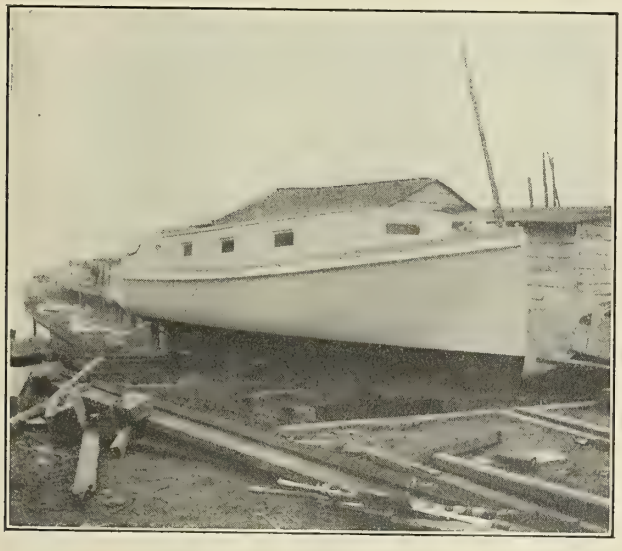
The exhaust and inlet valves of the engine are made of nickel steel, and are so located as to be removable without disturbing the rest of the engine. They are interchangeable and are operated by positive drive. The cam shaft, with the cam and all gears, are located in the inclosed crank chamber, being readily



THE LINES.

accessible on removal of the handhole plate. The gears on crank and cam shafts are of forged steel, with intermediate gears of bronze. Cylinders, heads and valve chambers are water-jacketed throughout, while the exhaust pipes are similarly treated as far as the base plate of the engine.

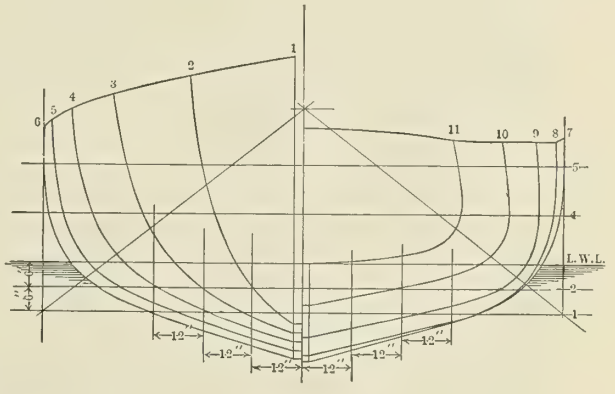
The reversing gear, which is mounted on the same bedplate, is operated by one lever and is housed in an oil tight case. For propulsion forwards, the reverse gear is locked, so that the gears revolve with the shaft. In reversing, the propeller may be given the same speed as when going ahead. The revolutions are 400 per minute normal, with a maximum of 500. The engine weighs complete 1,900 pounds.



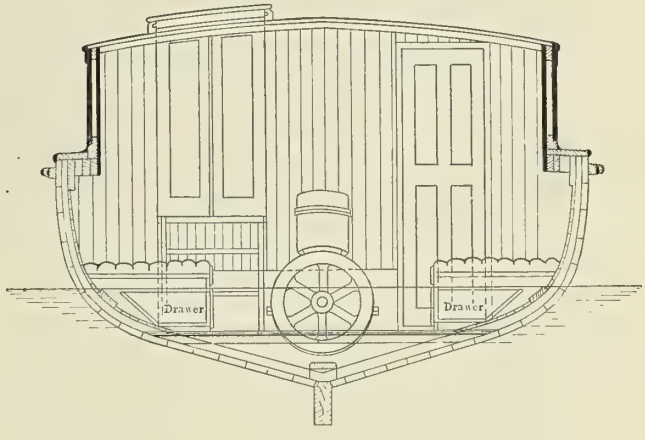
GENERAL VIEW OF THE LAUNCH.

In this launch it was the idea to get as much clear cabin as possible, and yet to have a good roomy cockpit. It will be seen that nearly all the weights are in the stern; the muffler being placed athwartship under the after deck, the gasoline tanks in the cockpit, the whistle tank, piping, and batteries, under the cockpit floor, the clothes closet, toilet room and engine—all these weights are well aft, and on a trip those on board will be in the cockpit most of the time. To keep the stern up it will be seen how full the lines had to be made aft, to allow for all the weights. They had to be spread out, and a comparatively short run given, to get the engine down as low as possible, so as not to have too great an angle on the shaft.

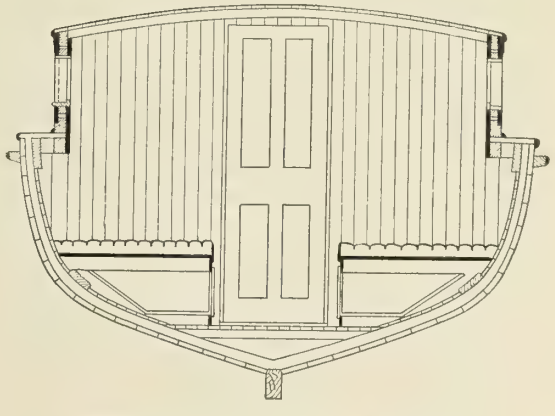
The boat runs well, handles well, leaves the water clean, makes 10 miles an hour, and is a comfortable and roomy craft for these dimensions. The name of the launch is *Bellrose*, and she is owned by O. A. Danzenbaker and Charles P. Stohlman, of Washington.



THE BODY PLAN.



MIDSHIP SECTION, LOOKING AFT.



SECTION SHOWING FORWARD END OF CABIN.

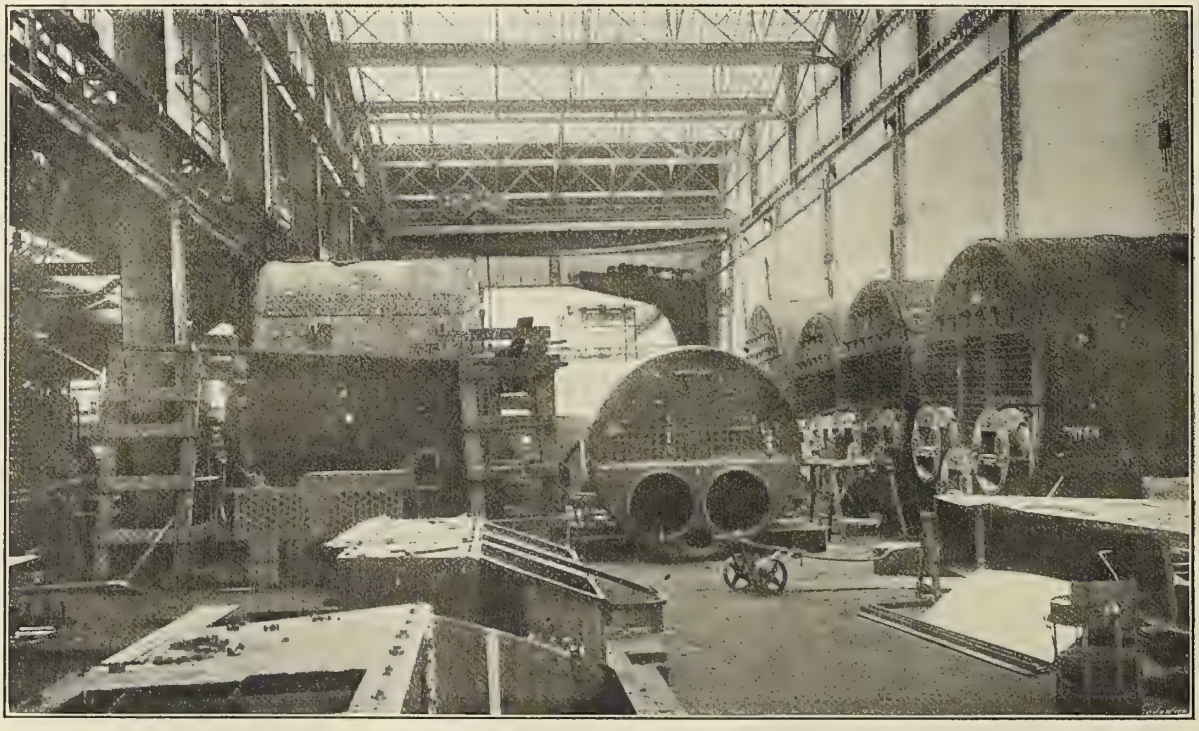
THE BOILER SHOP OF A LARGE SHIP YARD.

The maintenance of an industry in one locality for two hundred years, by one family in direct line of succession, is most unusual in the history of manufacturers. Such a record has been made by the Scotts of Scotts' Shipbuilding & Engineering Works, at Greenock, Scotland. As early as 1711 they began to build ships in Greenock, and today their descendants of the sixth generation maintain the highest traditions of the past years. Naturally the beginning of this concern was small, but today it has grown to be one of the largest engineering works in Great Britain.

These works cover an area of forty acres, and have ten berths for the construction of ships of all sizes with departments for producing all the accessories and machinery; engine and boiler works; steam turbine factory; foundries; brass, copper and sheet iron shops; saw mill and an extensive wood-working department. These give employment to over four thousand workmen.

The machines in the plate shed are designed to deal with plates up to fifty feet in length, and with angles up to sixty feet. All the tools are electrically driven. The plate straightening rolls, which have 15 to 20-horsepower reversible motors, can take plates eight feet wide. The bending rolls are driven by a 20-horsepower motor. One of the tools for drilling and countersinking plates is a three-standard drill, the spindles on which have a rise and fall of ten inches, and are fitted with automatic as well as hand feed. Nearly all the punching and shearing machines have 42-inch gaps. There is also a hydraulic stamping press for bending angles and tees, the cylinders being fourteen inches in diameter, working at a pressure of 800 pounds per square inch with a stroke of eighteen inches. The shop contains a great many hydraulic machines for joggling and scarfing the laps and edges.

The firm uses hydraulic riveters wherever possible, there being over twenty of these at work in the yard. Pneumatic tools are also extensively employed on the ships for boring, drilling,



GENERAL VIEW IN THE BOILER SHOP OF THE SCOTT SHIPBUILDING AND ENGINEERING WORKS.

Besides the boiler shop, there are other branches of the ship yard that are of direct interest to the boiler maker. The iron workers' department is extensive and important. For handling the material delivered into the yard from the railroad cars there is being installed a new 5-ton electric overhead traveling high speed crane. There are six furnaces suitable for heating shell plates of the largest size, and angles and bars for frames, etc., up to sixty feet in length. Adjacent to the furnaces are the scrieve boards and the frame bending blocks. Formerly the turning of the frames to the required curvature against the pins on the bending blocks was carried on by hand. To suit the heavier scantlings of the larger ships of the present day, a portable hydraulic machine is now used. It is fixed at its base by pins which fit into the ordinary holes of the block, and hydraulic pressure is supplied through a flexible pipe, to work the ram head against the angles, forcing them to take the desired form. This machine saves a great deal of labor, as the work is carried on in a minimum of time, and therefore at the highest heat. The bars were formerly cut to length by a guillotine, but it was considered that this had a tendency to twist the metal, and as a consequence a shearing and notching machine constructed by Messrs. Henry Pels & Company is now used.

riveting, chipping, calking, etc. There are from 130 to 140 of these tools in use on vessels in the course of construction.

THE BOILER SHOPS.

The output of the boiler shops during 1905 was practically one boiler per week, which is a testimony to the nature of the plant turning out the work. The main boiler shop, which, together with its yard, has an area of 7,000 square yards, has a height of forty-five feet to the crane rail, and is served by five overhead electric cranes ranging in lifting power up to 100 tons, besides numerous auxiliary cranes. There is a thirteen-foot gap hydraulic plate bending machine which is entirely automatic in its action, and can be set to any radius to bend plates up to two inches thick when cold. The flanging for the front and back plates of boilers is done in a hydraulic machine exerting a pressure of over 160 tons. This machine has four rams, two of which act downwards, one upwards and the other horizontally. It is served by a special hydraulic jib crane capable of lifting the heaviest plates. There are also plate edge planers and triple boring mills of corresponding power, while the vertical rolls take in plates up to ten feet in width. For the riveting of boilers, there is a thirteen-foot gap hydraulic riveting machine capable of exerting on each rivet a load of 200 tons. The weight of this

riveting machine is about 60 tons, and it is served by an independent hydraulic jib crane.

There is also a large installation in a special plant for the manufacture of water tube boilers. The amount of work done is perhaps the best indication of the equipment of this department. A set of boilers for a large cruiser can be turned out in six months; for these boilers over 24,000 tubes are required, all of which are coated electrolytically in a zinc bath.

In connection with the manufacture of large boiler taps, drill gauges, milling cutters, etc., a specially designed gas furnace has been built, with a number of compartments which can be used separately or collectively, according to the size of the tool being made.

The firm has always been noted for the rapidity of construction, especially in its engine and boiler works. A contract for the boilers and engines for twenty of the passenger steamers built for traffic on the Thames, to the order of the London County Council, was signed about December 1st, 1904, and all the twenty engines and boilers were completed by the end of May, 1905.

The Boiler Maker.

The Largest Steamers in the World.

A clipping, which purports to give a list of the ten largest steamers in the world, has been going the rounds of the marine press. The list is as follows:

Mauritania (Cunard), quadruple screw, turbine machinery	33,200.
Lusitania (Cunard), quadruple screw, turbine machinery	33,200.
Kaiserin Auguste Victoria (Hamburg-American), twin screw	25,000.
Adriatic (White Star), twin screw	25,000.
Baltic " " "	23,876.
Amerika (Hamburg-American), twin screw	22,250.
Cedric (White Star), twin screw	21,035.
Celtic " " "	20,904.
Caronia (Cunard), twin screw	19,594.
Carmania " triple screw, turbine machinery	19,524.

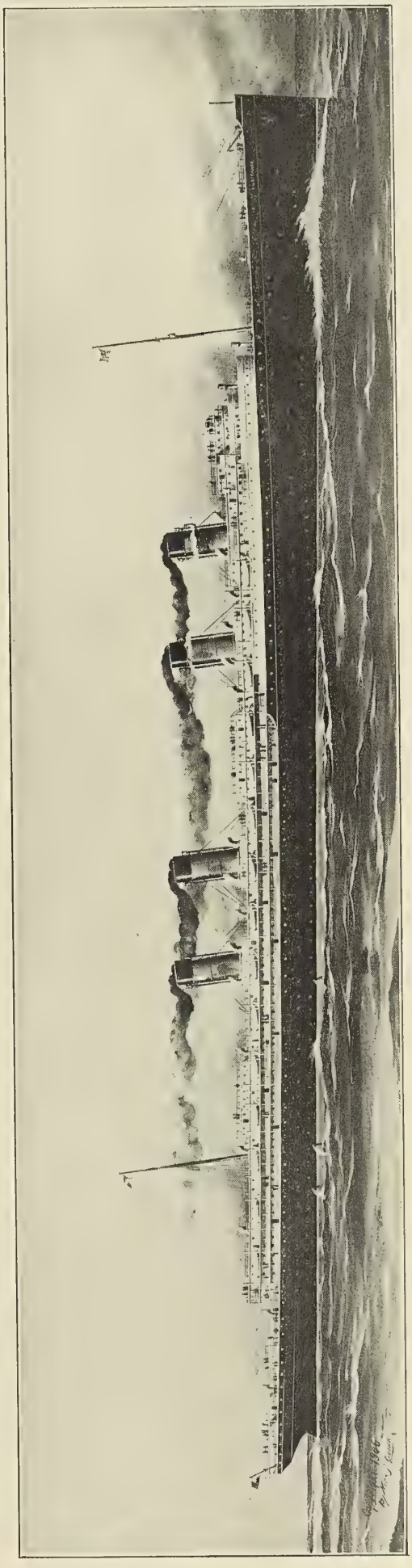
This list, which we understand originated in the office of one of our American contemporaries, is incomplete in that it failed to mention the two largest ships built in the United States, which are, in cargo carrying capacity, the largest ships afloat. Their gross tonnage is greater than that of two of the Cunarders above mentioned, though less than the other ships in the list. These vessels are, of course, the *Dakota* and *Minnesota* of the Great Northern Steamship Company, and of 20,714 and 20,718 gross tons respectively. These are twin screw ships, built by the Eastern Shipbuilding Company at New London, Conn.

THE LONDON COUNTY COUNCIL PASSENGER STEAMERS.*

BY ARCHIBALD HOGG.

The designing of suitable and economical steamers for the Thames passenger traffic at London was one of those interesting problems that every now and then come before naval architects. Had the shipbuilders been given a free hand, this problem would have afforded every opportunity for the exercise of all their knowledge and inventive faculties, but the significance of this fact does not seem to have been appreciated by the London County Council when they approached the builders for tenders, as they apparently satisfied themselves, with the minimum of external aid, as to the size and type of steamer which they gave to the builders, with hard and fast conditions as to the speed, draught of water and number of passengers to be carried, etc.,

*Paper read March 16, 1906, before North East Coast Institution of Engineers and Shipbuilders.



THE NEW CUNARDER LUSITANIA, NOW UNDER CONSTRUCTION, THE LONGEST AND FASTEST VESSEL YET PROJECTED.

that is, they practically fixed the design and dimensions of the steamers. They received in return a large variety of different proposals, which was a good indication of the difficulties in the design. Those builders whose designs most nearly fulfilled the stipulated conditions were asked to give a second tender and were each provided with copies of the same definite plan and specification of hull and machinery, giving all dimensions, thus relieving the builders from all responsibility for the successful working of the steamers. Their duty was performed when they produced the hull and machinery to the sizes given and had proved that the stipulated speed could be obtained.

Now the shipbuilder's business is to design as well as build steamers, and they usually give freely whatever design is necessary on receipt of certain information. They could therefore have been given such conditions as would have allowed them an absolutely free hand in determining the type and size of steamer. They could have been furnished with a plan of the river, showing the landings with the distances between, the speed of the river current, and also some idea regarding the probable average number of passengers to be carried over a given time, in short, all particulars affecting the running of the steamers. It may be taken for granted that scarcely two builders would submit exactly the same proposal, and the Council would thus have received, gratuitously, the valuable opinions of the shipbuilders. With this information before them they could have made a proper comparison and could have ascertained the relative economy of the steamers before embarking upon the scheme. The conditions to be fulfilled by the steamers, as fixed by the Council, were verging on the impossible. All shipbuilders know what this means as regards the first cost and the cost of running the steamers.

The Council's steamers were designed with too great a speed on the specified length of vessel and draught of water, and are consequently almost as uneconomical as it is possible to make them. The following instance illustrates how nearly the design approached the impossible limit. With the view, no doubt, of making the steamers quite up to date, the specification called for an electric light installation, the plant for which would weigh over 1¼ tons. The length of the steamer being restricted, it follows that the form of the hull must be increased in fulness in order to make up the necessary displacement. This extra fulness increases the resistance and requires an addition of about 10 indicated horsepower to the propelling machinery in order to propel the steamer at the 13 miles per hour, but this in turn means a further increase in the form, and consequently a further addition to the horsepower to propel it at the 13 miles per hour. It is probable that, at the very least, from 15 to 20 I.H.P. is used solely on account of having to carry the electric light plant. The cost of this extra propelling machinery is about £100 per steamer, or a total of £3,000, which, together with the cost of installing the lighting plant, is the actual cost incurred by fitting the electric lighting installation. And this is not all, as there is yet to add the yearly cost of the extra coal consumed, which is about £60 per steamer, or a total of £1,800 per annum, due solely to carrying the plant. Thus we see what a large price is paid and is being paid for the luxury of up-to-date lighting.

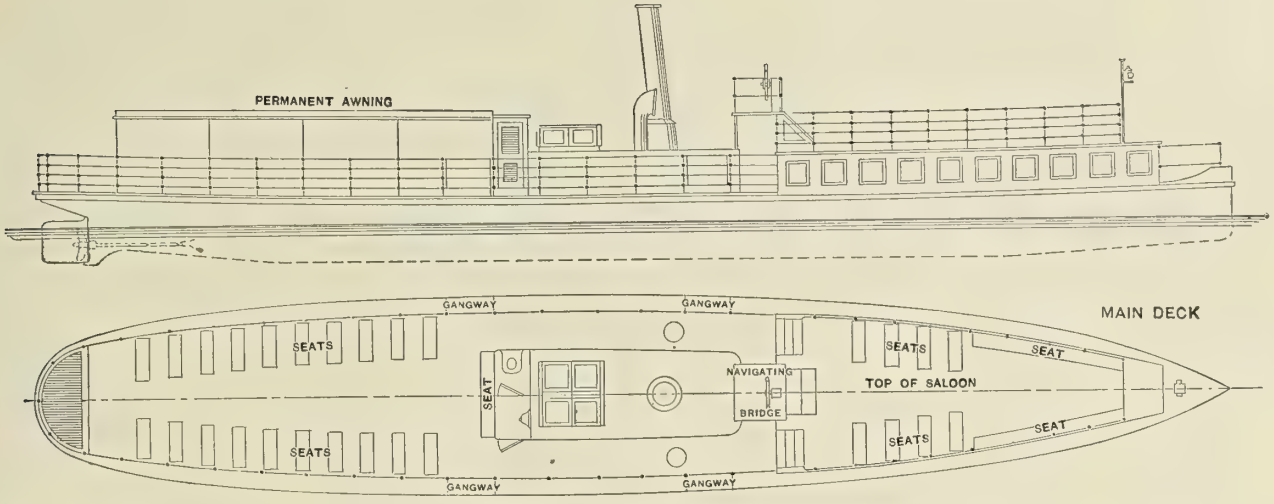
It will be readily understood that in a steamer of this nature a very considerable increase in the horsepower of the machinery is required to increase the speed by ¼ mile per hour. The specified speed was 13 miles per hour on trial, but the specified machinery proved sufficient to propel the steamer at 13¼ miles per hour. At first sight the addition of ¼ mile does not appear excessive, but when it is examined we find here another instance similar to that mentioned above. The trial results show that a smaller horsepower would propel the vessel at the 13 miles speed on the same form and displacement. This figures out at about 266 I.H.P., so that 34 I.H.P., or 13 percent, is absorbed in getting the extra quarter of a mile, which means that more weight of propelling machinery is being carried than was necessary. If the form of the hull had been fined down, reducing the displacement correspondingly, the 13 miles could have been obtained with even less horsepower, and thus a still further reduction could have been made. This goes on until a point of equilibrium is reached. This point is such that with machinery of about 230 I.H.P. the required speed of 13 miles per hour could have been obtained without altering the dimensions or the carrying power of the steamer. If this machinery had been fitted instead of the larger 300 I.H.P. engines, the reduction in the first cost would have been about £10,000, and the saving in the yearly bill for coal about £5,500 on the thirty steamers.

Another point in the design is the type of engines adopted. These steamers ply in very shallow water and consequently the hulls were constructed of material of very light scantlings, but this does not imply any weakness of the hull itself. What I call in question is the wisdom of fitting "paddle" machinery of 300 I.H.P. into hulls of such scantlings. The wear and tear due to the large engines and to their many stoppages and starts must be considerable and is bound to necessitate abnormal repairing. If screw engines had been fitted the abnormal wear and tear would have been greatly decreased and the vessels would have been equally easy to handle.

Again, with respect to the number of passengers to be carried, the London County Council fixed this at 500 and the boats were designed to carry 26 tons deadweight at a speed of 13 miles per hour on trial, with a length of steamer of about 134 feet overall, on a draught of water of 2 feet 10 inches. Assuming 3 tons for coal, etc., the remaining 23 tons weight would allow say 400 passengers on board, so that with 500 passengers on board the draught of water would be about 2 feet 11½ inches.

The given requirement of 500 passengers fixes the deck area independent of any question of draught of water, and thus the decisive factor in this design is the question of economic propulsion. The constant obtained by the Admiralty formula, $\frac{D^{\frac{2}{3}} \times V^3}{P}$, is a sure guide to the economy of the design, and in these paddle steamers it works out at a little over 130. Now this is not an economical constant for a steamer which has to do such work, and at the early stages in the proposal this fact should have received consideration, with a view to modifying the design of steamers, to carry fewer passengers at a lesser speed.

The type of steamer required for work in the Thames is not really what is usually understood by the term "River Passenger Steamers." Consequently, a vessel having a capacity similar to that of a street car, or rather larger, with a service at frequent intervals between the landings, would perhaps be more likely to meet the requirements of the traffic. Such a steamer is illustrated here. The dimensions are: Length, 90 feet between perpendiculars; beam, 13 feet; depth, 5 feet; and the vessel has one deck only for passengers, except in way of the saloon, which is sunk into the hull, with a raised roof upon which passengers may sit. Twin screw propellers are used instead of paddles, thus saving the weight of paddle boxes, sponsons, etc. This steamer would carry 150 passengers at a speed of 12 miles per hour with about 75 I.H.P. on a draught of water of 2 feet 10 inches, while the deck area provided allows for a maximum of about 200 passengers. It is probable that, while employing the same number of boats, they would carry, on an average, as many passengers as the present boats do. They would cost less and would be much more economical in the consumption of coal, etc. The saloon could be lightly panelled and the seats upholstered with cushions, while some of the steamers could be fitted with refreshment bars. Thirty of these steamers would cost about £95,000 less than the present boats, the yearly coal bill would be about £17,500 less, the other expenses, including insurance, would be correspondingly reduced, and the cost of upkeep repairs would be greatly curtailed. If thirty steamers were not sufficient to meet the traffic at certain times more vessels could be added. The fleet would be much more manageable with a larger number of smaller boats, and could be increased or curtailed as desired, which it cannot be at present without seriously



GENERAL ARRANGEMENT DESIGN FOR RIVER THAMES STEAMERS.

impairing the service. These ninety-feet boats are suggested as the largest size that should have been utilised, but it is probable that much better results might be expected from still smaller vessels.

THE NEW CARGO CARRIER BELLEROPHON.

New Type Cargo Liner.

An extremely interesting cargo steamer has just loaded at Glasgow for China and Japan, which merits some description as an example of the latest development in cargo boats. This steamer, the *Bellerophon,* is the sixteenth built and engined by Workman, Clark & Co., Limited, Belfast, for the Ocean Steamship Company, Limited, of Liverpool. She is unique in that she has no masts for carrying rig. Instead, she has four tall pillars, two abreast forward and two abreast aft, for carrying derricks. Between the two forward posts a bridge is fitted near the head for lookout purposes.

The *Bellerophon* is of 9,000 gross tons, and has been specially designed for trade to the far east. The holds are so arranged as to be clear of obstructions, in order to admit of the carriage of cargo of the most bulky character, such as machinery. In lieu of stanchions the decks are supported by strong fore and aft girders. There are seven holds, each of them being entered through large hatchways. For handling the cargo there are twenty-six powerful steam winches and derricks, while other appliances of the most approved type are provided, so as to deal with a full cargo in the most expeditious manner.

Although primarily a cargo boat, accommodation for a number of emigrants is provided in the forecastle and upper 'tween decks, with all the necessary conveniences. Accommodation for the officers and engineers is provided in a large steel four-story deckhouse amidships, and for petty officers in a deckhouse abaft the engine casing. These apartments are exceptionally large, and are comfortably furnished. The seamen's and firemen's quarters are in a steel deckhouse at the after end of the upper deck and at the after end of the main deck respectively. The vessel is lighted throughout by electricity, the installation including large cargo clusters, mast lights, and a powerful search light, fitted on the forecastle head, for use in the Suez Canal.

The propelling machinery consists of two sets of the latest type of triple expansion engines, complete with all necessary auxiliaries, supplied with steam from double-ended, multi-tubular boilers, working under the closed ashpit system of forced draught.

Before proceeding to Glasgow to load general cargo outwards for China and Japan the *Bellerophon* had a series of highly successful speed and other trials in Belfast Lough. The capacity of the cargo working appliances was thoroughly tested in the case of some very heavy castings which had to be taken on board, made by the Steel Company of Scotland for the dockyard at Nagasaki. These heavy lifts were handled by the *Bellerophon* with the greatest ease. Two more of this type of vessel are being built by Workman, Clark & Co., and a fourth by D. & W. Henderson & Co., at Glasgow.

Benjamin Taylor.

MOTOR BOATS, XII.

BY DR. WILLIAM F. DURAND.

LAYING DOWN AND ASSEMBLING.

Having thus considered the structural elements best suited to the construction of small boats, a few points may be noted in connection with the actual process of preparing and assembling these elements into the completed structure.

The first step will be to lay down the water lines and the sections at each frame full size on the floor or mold loft. The ordinates for these lines are taken from the lines as designed, and the resulting full sized lines are faired up in the same general manner described in connection with the operation of design. It must not be forgotten that the lines as commonly laid down on the drawing board relate usually to the outside of the frame or inside of the skin. In such case they are immediately available for determining the form of the frames. Some designers, however, prefer to lay down the lines to represent the actual water surface of the boat, and in such case the thickness of the planking must be taken off all along the section line in order to obtain the form for the frame.

If we assume that the boat is of moderate or small size and is to be built over fixed molds, the next step will be to determine the form of the molds. Not less than five such molds should be used in addition to the stem and stern post or form, and in some cases a still larger number will be found advantageous. The form of the mold is to be taken from the full sized sections, one-half on a single board, selected of width sufficient for the purpose, and this used as pattern for a duplicate, the two then being put together as in Fig. 57, thus forming the mold complete.

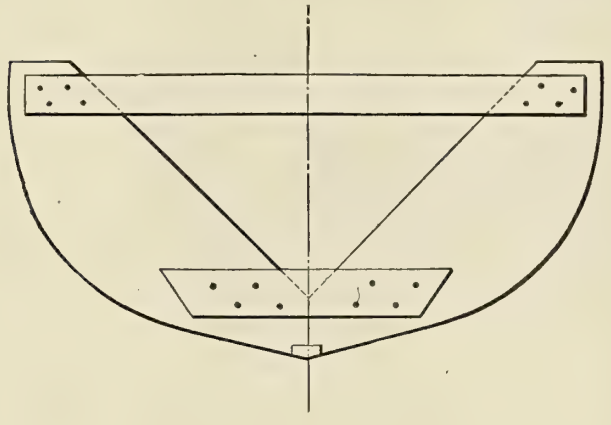


FIG. 57.

The form of the half section may be conveniently transferred from the floor to the board by laying down nails with their heads on the line of the section and the body standing at right angles. The board is then laid down on the nails and lightly pressed or struck with a hammer, thus making an imprint of the nail heads on the under side. A batten sprung through these will then give a satisfactory reproduction of the line on the board, and the mold may be cut to this line. Points showing the vertical center line are also noted, and from the half mold thus determined its mate is cut, and the two are joined as indicated in Fig. 57. The other molds being made in the same manner, the entire series is ready for assembling on the keel. The keel support may then be prepared, consisting of a two-inch plank blocked up on edge, and with the upper edge cut to fit the sweep of the keel. This plank, which is, of course, no part of the boat proper, makes a convenient and secure foundation for the further construction of the boat. It will be found a convenience to so adjust this support as to bring the designed water line of the boat horizontal.

Keel, Stem and Sternpost. These items may next be gotten out to dimension, and suitably rabbeted to take in the edge of the garboard strake of planking and the ends at the stem and stern. They are then erected in place on the keel support, and secured together with chocks and through fastenings after the manner indicated in the various illustrations showing structural features of this character.

Deadwood and Shaft-log. With the old form of stern the deadwood and shaft-log may next be gotten out and fitted in place. The shaft log is usually formed by a pair of timbers secured by through bolts, and provided with a longitudinal hole of size suitable for the shaft tube, and within which the shaft will ultimately find its place.

In the framework throughout, and especially in these longitudinal members, the joints between the timbers should be made tight with white lead and drawn close by means of through fastenings wherever possible.

Molds. The molds, made as above noted, may now be erected in place, centered and squared with the keel, and then secured by bracing and ties.

Ribbands. These are strips which are bent over the molds and lightly secured to them from one end to the other along the planking lines. These will serve to further secure the molds in place, and will also indicate any unfairness in the lines, should such exist. It will be an advantage to make the molds of sufficient height so that the upper ribband may be put on clear of the location of the sheer strake, thus providing a line of support for the frames until the sheer strake and clamp piece are secured in place. In small boats, furthermore, the ribbands are readily made of sufficient size and number to permit the frames to be bent into place against them and thus formed without the use of frame molds or bending floor.

Frames. The material for the frames may next be prepared, and the frames bent to form and secured in place. As noted above, small frames may be bent directly in place against the ribbands. After being properly sized, the frame is steamed and then taken directly to place and bent to form, secured to the keel, clamped to the ribbands and carefully adjusted in place. For heavier construction, where the frames cannot be readily bent against the ribbands, they are commonly brought to form on the bending floor. To this end the form of the frame on the inner or concave side is transferred in any convenient manner to the floor, and holes are bored along the inner edge, into which pegs are driven and against which the frame is then readily bent to form. In some cases, however, special molds are cut out for each frame and used as a foundation on which to bend the frame to form. Where the form of the frame will permit, it should run continuously from rail to rail, without joint at the keel. This however will be practicable only amidships; while forward and aft, where the angle at the keel is sharp, the frame will be made in two parts, secured together by a chock at the bottom. In either case, after being bent to form, the two sides of the frame are secured by cross ties so that it will retain its form when erected in place in the boat. When adjusted in place the frames may be secured permanently to the keel and temporarily to the ribbands. The fastening to the keel will include the fitting of chocks or bent floors with keelson, somewhat as indicated in Fig. 50.

Planking. This is to be gotten out in as long lengths as possible, tapered toward the bow and stern so as to carry the same number of strakes all the way fore and aft, and maintain as far as possible the planking edges at right angles with the frames.

Where the planking is double, the outer layer must be so arranged as to shift joints with the inner layer. The outer surface of the latter may be painted with thick white lead with special attention to the end joints and seams, and the joints and seams of the outer layer should be made with the same or

equivalent material. This will give a white lead filling in all joints and seams and between the two layers, which will serve effectively to make a watertight job of the planking as a whole.

The ribbands are, of course, removed in order to make way for the planking, except in the case of the upper ribband, which, as noted above, should be carried high enough to clear the sheer strake and clamp piece. After the latter are fitted and secured in place a few ties may be run across from one side to the other, the upper ribband removed, the tops of the frames sawn off, and the molds removed. The rail may then be finished as desired, either left as formed by the combination of sheer strake, clamp and frames, or with the space between the frames filled in, or with a cap piece covering over the sheer strake, clamp and space between.

Bilge and Side Stringers. In all first class construction and in all but the smallest boats, these should be fitted as a general addition to the longitudinal strength and stiffness of the boat.

Engine Bed. The general principles relating to the installation of the engine bed have been already discussed. The details will depend on the special design of the engine. Special precaution should be taken to avoid making it too short or too light, and particularly in high-powered boats, too great care can not be taken in so arranging the engine bed as to call into play the maximum amount of boat structure.

Seats. Whether the seats are run fore and aft or athwartships they should be supported on the skin of the boat by a suitable stringer piece run on the inside of the frames and secured to them. The seat should then be carefully secured to the supporting stringer in order that it may act as a tie or brace for the side of the boat. Transverse seats thus fitted give the boat great lateral strength, acting as ties or struts as occasion may demand, while a longitudinal seat fitted in the same manner will act in effect as a powerful side stringer, adding in marked degree lateral stiffness to the side of the boat. With fore and aft seats, the inner edge is of course carried on posts extending down and carried on a stringer piece attached to the frames. In some cases chocks are fitted under the seats to give added racking strength to the boat.

Deck Beams and Decks. Deck beams and decks over the covered spaces may be fitted next, not forgetting the installation of gasoline tanks or of any such feature which is to go in before the space is finally closed.

Planing and Finishing Exterior. After the preceding work is completed, the work of planing and finishing the exterior may be taken up. The planking is first rough planed, and the joints are then calked and filled with thick white lead or similar material. The surface may now be finally planed and smoothed up and made ready for painting and puttying. Much will here depend on the eye. The relatively thin planking will not permit the removal of any great thickness in order to fair up a part of the surface which may seem too high, and in order to realize the best result as regards external finished form, great judgment and care will be required. These facts call all the more emphatically for special care with the form during the earlier stages, and before it is too late to change the molds and correct any irregularities which may exist. If this part of the work is well done the form of the boat will, under the plane, scraper and sandpaper, come out smooth, continuous and pleasing to the eye.

Where the planking is worked in a double layer, the calking is unnecessary, though with thick planking it is sometimes employed. With thin planking, such as ¼ to ⅜ inch thick, however, it would be found very difficult to make the seam retain the cotton. For this reason, among others, when very thin planking is to be used it must be worked in double thickness with shifted seams, thus obviating the need of a calked joint.

In painting, three or four coats will be none too many, rubbed down somewhat between each coat, and with plenty of time for drying allowed. This, if well done, will give an outer surface smooth, hard and durable. Below the water line some good marine or anti-fouling paint may be used, while above, good white lead, or color in a white lead base, is to be recommended.

Thus far the type of construction more especially in view is the small boat made over molds and with dead-wood and the old form of stern. With larger boats of the same general type the frames will be heavier and stiffer, and the use of molds is no longer needful or common. The frames are prepared, bent to form and secured in place all in the same general manner as described. This operation being completed, the boat is then "in frame," and the planking and other structural and finish features are carried out along the same general lines as for the smaller type of construction.

For boats with the torpedo-boat or modern stern, the constructive operations are of the same general nature, and involve the same underlying principles as for the older type. With the modern stern the keel is usually flat rather than bar-formed —the more common style of keel with the older stern. These differences are shown in the various structural views.

A further item of difference is found in the dispositions suitable for taking care of the shaft and shaft tube where it passes through the bottom of the boat. Suitable material must be provided at this point, as indicated in the structural cuts, in order to properly secure the tube to the boat and give adequate support to the shaft. In addition to the bearing for the shaft where it passes through the bottom of the boat, there will also be required an additional support at the extreme end of the same, just forward of the propeller. This is usually in the form of a hanging bracket formed of structural steel or cast bronze, and supporting a suitable bearing for the shaft, the general arrangements being indicated sufficiently in the various illustrations.

The style of boat construction in view throughout these suggestions is of the plain normal type, such as is met with in the average small or moderate sized motor boat, and where no special requirements involving extra speed or lightness are in question. For such special cases various structural features, including special methods of framing, extra thin planking with or without varnished fabric between, etc., have been noted at an earlier point, and will not require further mention here.

These brief hints regarding practical boat construction are furthermore intended only to outline the general processes, chiefly as illustrative of the principles dealt with at an earlier point, and as indicating to the non-technical reader the general routine of operations which may be followed in work of this character. It must be understood that there will be a vast number of problems of fitting, adjustment and procedure, with which the practical builder must deal as best he may, and which can not be covered in any written description of such work. Details of construction must vary with the particular features and requirements of the case, and in these pages no more is intended than to give some notion of the underlying principles involved, with sufficient illustration of their application to stimulate an intelligent study of such problems on the part of those who may be brought into contact with them.

The world's record in gunnery has been established on the battleship *Ohio* by D. M. Dean, whose score was thirteen bullseyes out of thirteen shots in one minute, with a 6-inch gun. The *Ohio* was steaming at 10 knots at the time, and the target was distant 1,600 yards. The best previous record for this size gun was eleven hits out of fourteen shots, made by one of the gun pointers in the British navy. When it is realized that as recently as the Spanish war the 6-inch guns, as fitted on the *Oregon*, were capable of only about two shots per minute, the importance of this record and the immense forward strides which it indicates become all the more apparent.

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Shipbuilding and the Merchant Marine.

The arrival in the port of New York during the last six weeks of three important new ships belonging to as many transatlantic lines flying the flags of European continental nations has served to emphasize the immense importance of the passenger and freight traffic on the North Atlantic, between the port of New York and the ports of Great Britain and the north of Europe. We pointed out in our issue for December last that there were at that time under construction, or had recently been completed, for European ship owners, to be used in the New York trade, no less than ten immense steamships, the aggregate tonnage of which was more than two hundred thousand. Of these ten, five have already made their first voyages, while the others are expected at some time within the next year.

As our readers are well aware, it is a matter of extreme humiliation to Americans that ships flying the flag of the United States have so little a share in this great enterprise. There has not been constructed for several years an American ship for the North Atlantic trade and there appears to be little prospect of any such construction for a number of years to come.

At present about 11 percent of our imports and exports by sea is carried in American bottoms, the remaining 89 percent being transported mainly by English, German and Norwegian vessels. It goes without saying that no one nation can conserve to itself with any propriety or regard for the rights of others its entire carrying trade. It will not be questioned, however, that as a general proposition each nation is entitled to about 50 percent of its carrying trade. This figure is based on the fact that all exports and imports are necessarily mutual propositions as between two countries, and each is legitimately entitled, from a theoretical standpoint, to an equal share in the transporting of such commodities.

It is needless to remind our readers that there is at present before congress a bill looking toward the improvement of such conditions from the American point of view, although the provisions of this bill do not contemplate any action with regard to the North Atlantic. A considerable number of new shipping lines is aimed to be establshed between the United States and the east and west coasts of Central and South America. These are urgently needed, because of the fact that it is not now possible to make direct mail connection with Brazil or the Argentine Republic except by very slow and infrequent ships, and with a service not at all satisfactory. As a matter of fact, both Brazil and the Argentine Republic are as near to Liverpool as they are to New York, but they are not as near New York by way of Liverpool as they are to New York direct, yet nearly all important business has to go by this circuitous route in order to be taken care of with any degree of celerity or regularity. The establishment of these new lines, with steamers of fair speed and absolute regularity of sailing, ought to do much toward fostering the trade of the United States with her southern neighbors, and as such ought to redound very largely to the benefit of American manufacturers and exporters.

The Big Battleship Craze.

Since the English battleship *Dreadnought* was projected, and particularly after the great interest was developed at the time of her launching, other powers have fallen into line with projects for battleships of equal or greater displacements, and there seems to be no disposition to spare expense in the carrying out of programs involving these immense ships. The German proposition calls for ships of 19,000 tons as against 18,500 in the *Dreadnought;* the French have under contemplation three ships of 18,000 tons each; the Japanese are reported to have already under construction in their own yards two ships which are variously

reported as from 19,000 to 22,000 tons each; the United States program includes one ship, the details of which are left to the Navy Department, but which seems likely to reach the 20,000-ton mark; while the Russians have an ambitious program involving among other things nine ships of 16,900 tons each.

There is no doubt that with the increasing displacements the amount of military value possible to be put into a ship is increasing in an even higher ratio. This is due to physical causes into which it is unnecessary to enter here. On the other hand, these immense ships lack handiness, mobility and general adaptability to diverse circumstances in such degree that it seems to us a mistaken policy to carry the matter to such extreme dimensions. During the last three or four years, there seems to have been a general policy for the maximum of design to crystallize at about 16,000 to 16,500 tons, and on this displacement excellent ships have been designed, more powerful in every way than was any ship engaged on either side in the Russo-Japanese war, upon the results of which war the new designs are said to be based. Equal fighting capacity cannot be obtained in a 16,000 ton ship as compared with one of 18,000 or 20,000 tons; but for equal expenditures from the national exchequer there is little doubt that the results obtained with the smaller ship will be equal in all essential particulars, and superior in many, to those obtained with the immense constructions into which the naval powers are now rushing with such abandon.

Naval Comparisons.

Much uncertainty has been manifested regarding the relative strength of the French, the German and the American navies, each of which has been severally claimed to occupy second place among the war fleets of the world. A satisfactory basis of comparison as between individual ships, and between groups of ships, and entire navies has yet to be found. Many methods of procedure have been proposed at various times, and have had more or less evidence of good sense in their make-up, but no method has been devised which will give in any way a conclusive comparative result as between two ships of approximately equal power, but dissimilar in the several elements of battery, protection, speed, steaming radius, handiness and general adaptability which go to make up that power.

As a general proposition, when it comes to a question of comparing entire navies, the most satisfactory of the numerous processes which has come to our attention is one basing the result upon displacement in the several classes of ships. This, however, in order to be generally applicable, must necessarily take account of the several dates of construction of the ships, and must discount ships the age of which is such as to make it certain that their elements of naval value are necessarily inferior to those possessed by ships of a later date. This method of comparison assumes that the naval architects designing the various ships are of equal ability, which is by no means always the case. It assumes, furthermore, that the problem of design has been carried out in approximately the same manner in one ship as in another, which is also not usually the case. It has, however, the beauty of simplicity, and certainly does give a general idea upon which deductions may be based. In the absence of a satisfactory scientific substitute, this method is perhaps the best one to be employed.

An article in this issue compares the French navy with the German, and a supplement has been given showing how the American navy compares with the other two. It should be noted that this comparison is based on displacement and gun power alone, without any effort to discount the older ships in any way, and as such the results should be considered as approximate only.

The Lengthening of Steamers.

Two or three years ago there seemed to be a sort of epidemic, on the Great Lakes, of lengthening the freighters which had been somewhat outgrown in size by later competitors. The peculiar form of Lake ships, with long parallel middle bodies, adapts itself readily to this method of operation, and as the loading and unloading docks are provided with facilities in multiple stationed just 12 feet apart, the additional length was necessarily made in multiples of 12 feet, a common figure being 72 feet.

This process has not been carried on to so large an extent on the seaboard, partly because of the fact that the forms of the ships are not so readily adaptable to this procedure, and partly because it has been found more advantageous in most cases to continue to operate the old ships or to substitute new ones for them. The Old Dominion Steamship Company, however, has recently lengthened several of its ships, removing from service one at a time, and the description in this number of the lengthening of the *Hamilton* gives a good general idea of the operation. The reason given for having adopted this method to increase the carrying capacity of the fleet, rather than to have constructed new ships, is one based purely on commercial grounds, and is a good exhibition of the sound policy usual prevailing in such matters.

The operation of actually separating the parts of a ship a given distance, and leaving them so perfectly in line that the new material can be erected into position without in any way disturbing the lines and form, is a very delicate one, but it is not on record that any difficulty has been experienced in carrying out this program with entire satisfaction to all concerned.

ABSTRACT FROM RULES AND REGULATIONS OF BUREAU VERITAS.

EDITION OF 1905.

ARRANGED BY HARRISON S. TAFT.

PART II.

9. Bilge and Floor Keelsons. Side Stringers.

1. Bilge Keelsons

(*a*) A keelson consisting of two angle bars riveted back to back is to be fitted at the lower turn of the bilge in all vessels except in way of a continuous or partial double bottom. In vessels of 14 feet or more in depth a similar keelson is also to be fitted at the lower turn of the bilge. Said keelsons are to extend as far forward and aft as possible.

(*b*) When the depth of a vessel is 25 feet and over, a bulb plate is to be fitted to the lower bilge keelson for ⅔ length amidships. In all vessels of 14½ feet depth and over, a bulb plate is to be fitted to the upper bilge keelson for ⅛ of vessel's length forward, but it should extend aft so as to scarph with the amidship bulb when fitted to the lower bilge keelson as stated above.

(*c*) For arrangement of upper bilge keelsons see table 3.

2. Floor Keelsons.

(*a*) A keelson consisting of two angle bars riveted back to back embracing the top edge of intercostal plates is to be fitted on top of floors midway between the center line and the lower bilge keelson in vessels over 32 feet in breadth or over 275 feet in length; also in all three and spar deck vessels.

(*b*) The angle bars are to extend forward and aft as far as possible; the intercostal plates for the ⅔ length amidships. The intercostal plates are to be secured to the shell in all cases by a single clip equal to the reverse frames, and with a similar clip to the floors whenever said floors amidships are 22 inches in depth at center line.

(*c*) When said intercostal plates are not required, wash plates must be fitted, being of the same weight as the lower part of watertight bulkheads and extending for ⅔ length amidships. They are to be secured to the floors by angle clips. If a vessel of less than 26-foot beam has an intercostal or a continuous vertical center line keelson, said wash plates need not be fitted.

3. Side or Hold Stringers.

A hold stringer is to be fitted midway between the upper bilge keelson and the lower tier of regular deck beams; all as indicated in table 3.

4. All keelson and stringer angle bars are to maintain their midship scantling for ⅔ length amidships. Fore and aft of said ⅔ a reduction of $\frac{1}{16}$ in thickness will be allowed in all angles of and over ⅜ inch thick.

5. The distance on the girth of the frame from the bilge keelson to the hold stringer or from hold stringer to hold stringer is not to exceed 6 feet.

6. The smaller flange of all longitudinal angle bars is to be secured to the frames or reverse frames, except for middle line keelsons, where the larger flange is to lay horizontally, with the smaller flange standing vertically.

7. In vessels navigating in ice, additional double angle bar keelsons must be fitted forward not more than 4 feet apart.

10. Floor Clips.

1. Angle clips are to be fitted on top of all floors and on all frames in way of all angle or plate stringers, to which the stringer angles are to be riveted. Said angle clips need not be fitted when intercostal plate keelsons, connected to the shell and to the floor plates, are adopted.

2. When bulb angle frames are adopted two angle lugs are to be fitted in the way of all keelsons and stringers. One lug may be used if of sufficient size to admit of 4 rivets in the keelson angle and three in the frame. In way of intercostal keelsons one lug only may be used.

11. Continuity of Keelsons.

When the continuity of keelsons or stringers is interrupted at bulkheads, gusset plates of the same thickness as the keelson angles must be fitted on each side of said bulkheads and riveted to each other so as to maintain the strength of said keelsons. When keelsons are worked continuous through a bulkhead, watertight collars must be fitted thereat.

12. Plate Side Stringers in Holds and Hold Beam Stringers.

1. All of said plate stringers are to be secured to the shell plating by angle clips worked intercostally between the frames, with a continuous angle bar worked at the face of the frames, said face bar being riveted to the reverse bars and reverse clips on the frames.

2. The stringer plates are to be supported by plate brackets worked on alternate frames whenever the beam spacing exceeds two frame spaces.

3. All stringer plates are to be worked continuously through all watertight bulkheads and are to be connected to a breast hook at each end.

4. When any holes are cut in a stringer plate for pipes, etc., compensation must be made for said holes.

5. The width of the stringer plates is to be measured from the inside edge of the frames except when the plates are not cut by the frames, in which case they are to be measured from the shell plating.

6. The midship scantling of the stringer plates is to be maintained for ½ length amidships; that of the angle bars for ⅔ length amidships. A reduction of $\frac{1}{16}$ in thickness will be allowed in angles of and over ⅜ inch thick beyond said ⅔ length.

TABLE 3.— ARRANGEMENT OF DECK BEAMS, BILGE KEELSON AND HOLD STRINGER.

Type of Ship	No. S. H. B. Tiers	Molded Depth to Upper Deck Amidship to Second Deck In Awning Deck Vessels	TYPE OF UPPER BILGE KEELSON AND HOLD STRINGER	
			Upper Bilge Keelson	Hold Stringer
One Deck Vessels	None	Feet under 12	—	DA
		12 " 13	—	DA+IP
		13 " 14	—	12" PS+SFB
		14 " 15	DA	15" PS+SFA
	One	15 " 16	"	PS+SFA+SHB
		16 " 17	"	"
		17 " 18	"	PS+DFA+SHB
		18 " 19	"	"
		19 " 20	"	PS+DFA+FP+SHB
		20 " 21	DA+IP	"
		21 " 22	DA	a "
Two Deck Vessels	None	22 " 23	"	DA+IP
		23 " 24	"	PS+SFA
	One	24 " 25	"	PS+SFA+SHB
		25 " 26	"	"
		26 " 27	"	"
		27 " 28	"	PS+DFA+SHB
		28 " 29	DA+IP	"
		29 " 30	DA	a PS+DFA+FP+SHB
		30 " 31	"	b "
Three Deck Vessels	None	31 " 32	DA+IP	DA+IP
		32 " 33	DA	PS+SFA
		33 " 34	"	"
		34 " 35	"	PS+DFA
	One	35 " 36	DA+IP	PS+SFA+SHB
		36 " 37	"	"
		37 " 38	"	a PS+DFA+SHB
		38 " 39	DA	PS+DFA+FP+SHB
F	S	39 " 40	"	DA+IP
		40 and above	—	—

F=Four Deck Vessels; S=Special Consideration; DA=Double Angles; IP=Intercostal Plate; PS=Plate Stringer; SFA=Single Face Angles; DFA=Double Face Angles; FP=Face Plate; SHB=Strong Hold Beams; Plus Sign (+) Means "With a."
a. An additional double angle bar stringer between hold stringer and upper bilge keelson
b. An additional double angle bar and intercostal plate stringer between the hold stringer and upper bilge keelson.
Deck beams spaced 2 frame spaces apart.
Stronghold beams " 10 " " "

13. Web Frames in Engine and Boiler Space.

1. All steamers of 15 feet or more in depth are to have web frames fitted in their engine and boiler compartments and also in athwarthship coal bunkers within range of same. The web frames are to be spaced two frame spaces closer than given in table 4.

2. They are to extend to at least the height of the crown deck of the compartments they are fitted in.

3. Deep framing may be substituted for web frames, in which case said framing must be ½ inch deeper and $\frac{1}{16}$ thicker than given in table 5.

14. Web Frames with Side Stringers in Lieu of Hold Beams.

1. Said web frame plating is to be of the same thickness as the flange of the frame bar to which it is attached. Double reverse bars are to be worked on the inner edge of said plate.

2. The web frames are to extend from the deck above the tier of beams dispensed with to the floors. In no place shall a web frame floor be of less width than the width of the web frame. They are to be secured to their respective deck beams by large plate brackets. If a web frame does not come at a beam, bracket plates must be worked on both sides of the deck stringer plate in way of said web frame.

3. The side stringers are to be of the same thickness and width as the web frames and in general have double angle bars of frame size on their inner edge. (See table 4.) When the frames are deeper than ordinarily required the side stringers must be of increased thickness to compensate for the extra reduction in cross section at frames.

4. The side stringers may be worked continuously through or intercostally between the web frames. In either case there is to be a double angle clip of reverse bar size and diamond plate connection at the intersection of the web frames and stringers.

5. SAILING VESSELS.

When said vessels are 23 feet and more in depth to the upper deck two web frames should be fitted in way of each mast on each side of the vessel. Said webs should extend to the deck stringer connected to the sheerstrake to which the chain plates of the lower rigging are riveted. Said web frames may be omitted if a bulkhead is fitted at mid-length or other forms of strengthening are adopted in way of said masts.

15. Deep Framing in Lieu of Web Frames.

1. When deep framing is adopted in lieu of web frames, the depth of said framing is to be as found in table 5. Said framing is to extend to the lowest tier of regular deck beams.

TABLE 4.—WEB FRAMES IN LIEU OF HOLD BEAMS.

Type	Single Deck Vessels						Multiple Deck Vessels							
a. Molded Depth to Upper Deck amidships To Second Deck in Awning Deck Vessels Feet	Web Frames		b. Plate Side Stringers				No. of Deck Tiers	e. Depth to Lowest Deck Feet	Web Frames		Plate Side Stringers			
	Depth Inches	Spacing Frames	Number	Face Angles Upper	Middle	Lower			Depth Inches	Spacing Frames	Number	Face Angles Upper	Middle	Lower
15 under 16	13	8	Two	SA	—	SA								
16 " 17	13	8	"	"	—	"								
17 " 18	14	8	"	—	—	DA								
18 " 19	14	7	"	DA	—	"								
19 " 20	15	7	Three	SA	DA	SA								
20 " 21	15	6	"	"	"	DA								
21 " 22	16	6	"	DA	"	"								
22 " 23	17	5	"	"	"	"								
23 " 24	18	5	"	"	"	"								
24 " 25	17	6	"	"	SHB+SFA	"								
25 " 26	18	6	"	"	"	"								
26 " 27	18	6	"	"	"	"								
27 " 28	19	6	Four	SA	"	c. SA	Two	16½ under 17½	17	7	Two	DA	—	DA
28 " 29	19	5	"	"	"	d. "		17½ " 18½	18	7	"	"	—	"
29 " 30	20	5	"	DA	"	c DA		18½ " 19½	19	7	"	"	—	"
30 " 31	20	5	"	"	"	c. "		19½ " 20½	19	7	Three	SA	DA	"
31 " 32	—	—	—	—	—	—		20½ " 21½	19	6	"	DA	"	"
32 " 33	—	—	—	—	—	—		21½ " 22½	20	6	"	"	"	"
33 " 34	—	—	—	—	—	—		22½ " 23½	21	6	"	"	"	"
34 " 35	—	—	—	—	—	—		23½ " 24½	22	5	"	"	"	"
35 " 36	—	—	—	—	—	—		24½ " 25½	23	5	"	"	SHB+DFA	"
36 " 37	—	—	—	—	—	—		25½ " 26½	24	5	"	"	"	"
37 " 38	—	—	—	—	—	—	Three	9 " 20	24	6	Two	"	—	"
38 " 39	—	—	—	—	—	—		1 " 21	24	6	"	"	—	"
39 " 40	—	—	—	—	—	—		21 " 22	24	6	Three e	SA	DA	"
								22 " 23	24	6		DA	"	"
								23 " 24	24	5		"	"	"
								24 " 25	25	5		"	"	"

SA=Single Angle: DA=Double Angles: SHB=Strong Hold Beams 10 frame spaces apart: SFA=Single Face Angle.
a. This column applies to both types of vessels.
b. A wide Stringer is to be worked in way of Strong Hold Beams.
c. An additional Plate Side Stringer of same construction at upper bilge.
d. An additional Plate Side Stringer with double face Angles at upper bilge.
e. Height between decks taken as 7 feet 6 inches.
Plus sign (+) means "with a."

2. The plate side stringers are to be worked intercostally between the frames with a single clip to the shell. Their thickness is to be the mean between that of the frames and the side plating. Their width is to be equal to the depth of the framing plus the width of the flange of the face angle bar.

3. If a single face bar is used on the inner edge of the side stringer its sectional area must equal that of the double keelson angles, with a broad enough flange to permit of two rivets to the reverse frames. When three or four face angles are called for the width of the side stringer plate must be such as to provide for riveting the broadest flange of said bars to said plate.

4. Bulb angles may be adopted in place of angle bars for face angles if of the same strength.

TABLE 5.—DECK FRAMING IN LIEU OF WEB FRAMES.

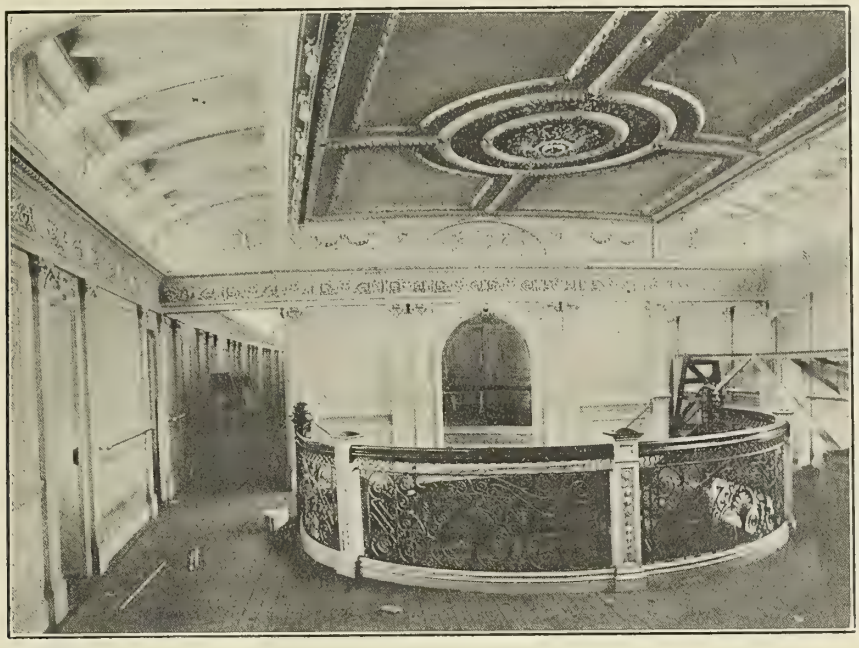
a Molded Depth to Upper Deck Amidships; to Second Deck in Awning Deck Vessels Feet	SINGLE DECK VESSELS						MULTIPLE DECK VESSELS						
	Depth of Framing Inches	b Intercostal Plate Side Stringers					No. of Deck Tiers	d Depth to Lowest Deck Feet	Depth of Framing Inches	Intercostal Plate Side Stringers			
		Number	Face Angles Upper	Middle	Lower					Number	Face Angles Upper	Middle	Lower
15 under 16	6	Two	SA	—	DA								
16 " 17	6½	"	"	—	"								
17 " 18	6½	"	DA	—	"								
18 " 19	7	"	"	—	"								
19 " 20	7½	"	"	—	"								
20 " 21	7½	Three	"	DA	"								
21 " 22	8	"	"	"	"								
22 " 23	8½	"	"	QA	"								
23 " 24	9	"	"	"	"								
24 " 25	8	"	"	SHB+SFA	"								
25 " 26	8	"	"	"	"								
26 " 27	8½	"	"	"	"								
27 " 28	8½	Four	"	"	c "		Two	16½ under 17½	7½	Two	DA	—	DA
28 " 29	9	"	"	"	c "			17½ " 18½	8	"	"	—	"
29 " 30	9½	"	"	"	c "			18½ " 19½	8½	"	"	—	"
30 " 31	10	"	"	"	c "			19½ " 20½	8½	Three	SA	DA	SA
31 " 32	—	—	—	—	—			20½ " 21½	9	"	DA	"	DA
32 " 33	—	—	—	—	—			21½ " 22½	9½	"	"	"	"
33 " 34	—	—	—	—	—			22½ " 23½	9½	"	QA	"	"
34 " 35	—	—	—	—	—			23½ " 24½	10	"	"	"	"
35 " 36	—	—	—	—	—			24½ " 25½	9	"	SHB+QA	"	"
36 " 37	—	—	—	—	—			25½ " 26½	9½	"	"	"	"
37 " 38	—	—	—	—	—		Three	19 " 20	9	Three	DA	QA	"
38 " 39	—	—	—	—	—			20 " 21	9½	"	"	"	"
39 " 40	—	—	—	—	—			21 " 22	9½	"	TA	"	"
								22 " 23	10	"	"	"	TA
								23 " 24	10½	"	QA	"	QA
								24 " 25	10½	"	"	SHB+QA	"

SA=Single Angle; DA=Double Angles; TA=Triple Angles; QA=Quadruple Angles; SHB=Strong Hold Beams 10 frame spaces apart; SFA=Single Face Angle; Face angles to be riveted to reverse bars.
a. This column applies to both types of vessels.
b. A wide stringer to be worked in way of strong hold beams.
c. An additional intercostal plate side stringer of same construction at upper bilge.
d. Height between decks taken as 7 feet 6 inches.

ENGINEERING SPECIALTIES.

Composite Board.

There has recently come into use among ship builders of this country an article which promises to supersede in a large degree wood panels on board steamers of all classes. We refer to "composite board," manufactured by the Composite Board Company, of 26 Cortlandt street, New York. This material being composed entirely of wood pulp, possesses all the advantages of wood itself, but having no grain, will neither warp nor split, and is impervious to moisture.

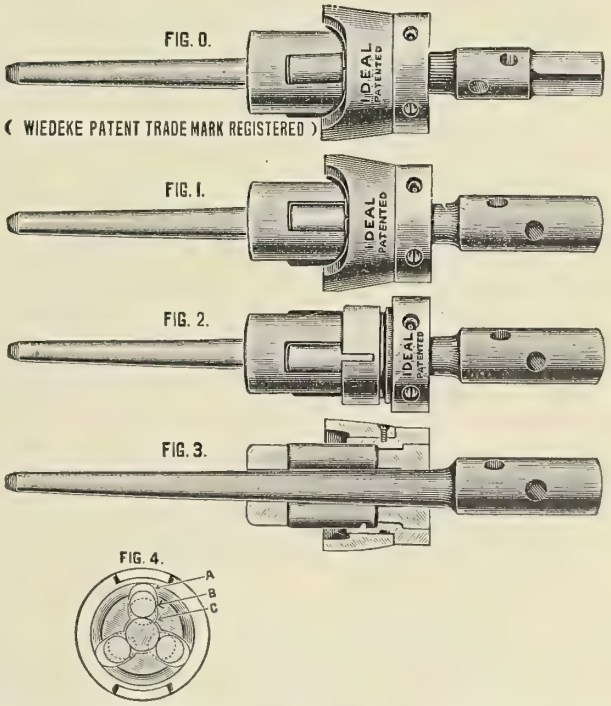


In its manufacture the wood pulp is reduced to a semi-liquid condition, and after the introduction of various chemicals, is formed in sheets ¼ inch thick and kiln dried. This process produces a hard flat board of uniform thickness, which, after further manipulation, is cut to desired dimensions, and the different sections are then glued under very heavy pressure, and allowed to dry thoroughly before finishing. By this process, the manufacturers are enabled to produce a finished board or panel of any thickness, 8 feet wide and 14 feet long, with perfectly smooth surface. The advantages of material of such dimensions for use in bulkheads, ceilings, and doors of steamers is at once apparent, not only on account of labor saving in fitting, but the advantage of having an unbroken, jointless surface. Besides flat sections for ceilings and panels, it is furnished curved to any radius, for use as casings to masts, or where circular sections are required.

Experiments prove composite board to be nearer sound proof than other materials, while as a non-conductor of electric current it is far superior to wood, sections ¼ inch thick having withstood upwards of 25,000 volts without piercing, and board ⅜ inch thick, more than 50,000 volts. The material is absolutely fire resisting, without the objectional features of so called fireproof wood. As it can be made of any desired thickness, it is also adapted for moldings of any section. Among the steamers equipped with composite board may be mentioned the *C. W. Morse,* now in service between New York and Albany, the Fall River Line steamer *Providence* and the *Merida* of the Cuban Mail Steamship Company. The accompanying cut shows its application on the *Providence,* the ceilings of large staterooms being made of a single piece, and all panels in the stateroom hall, as well as dome ceiling, being of the same material.

The Ideal Boiler-Tube Expander.

This expander, which is placed upon the market by Gustav Wiedeke & Company, of Dayton, Ohio, is said to be most simple and durable, with very great advantages as compared with many other types of roller tube expanders. The rolls are double the length of those in the ordinary expander, and are reversible which makes their life twice as long as in other cases. They can also be replaced with great facility, all that is necessary being the removal of the split cotter and of the cap in the rear, upon which the rolls will fall out automatically.

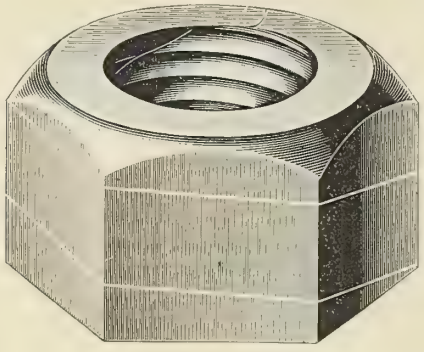


The roller frame is so constructed that the rolls cannot drop, even if the mandrel is removed, because of shoulders holding them in place. There are no cap screws to cause trouble, and the guard is readily removed when it is desired to work close to a boiler shell or rivet line, this being necessary in many

To use the Ideal tube expander, the rollers are set at the proper angle, and as soon as the mandrel is forced against them, it takes hold and gradually feeds its way in, thus producing a steady and even expansion of the tube and dispensing with hammering. The mandrel is so arranged that it can be used by hand power or by air drill power, whichever happens to be the better available for the case in hand.

The Helicoid Lock-nut.

This nut, which is placed upon the market by Bayliss, Jones & Bayliss, Limited, of 139 Cannon street, London, E. C., is made by coiling cold on a mandril a bar of steel of special section in such a manner as to form a close helical coil with a permanent set. This coil is then sawed into suitable lengths to correspond with the size of the nut, the blanks being then tapped, faced, shaped as required, chamfered and countersunk at both ends.



In tapping, the threads are cut to the same pitch as those of the bolt, but as the internal diameter of the nut is made slightly smaller than the diameter of the bolt, the nut necessarily expands on being put into place, and the spring of the coil is sufficient to hold it rigidly in position. This close gripping contact covers the entire length of the threads in the nut, and it is said that vibration will not shake it loose.

These nuts are made in seventeen sizes, to fit bolts from ¼ to 2 inches in diameter, and are tapped to Whitworth standard threads.

TECHNICAL PUBLICATIONS.

The Book of Boats. By Raymond Cavanagh, with drawings by E. P. Seidel. Size 5 by 6½ inches. Pages, 124; illustrations, 60. Chicago, Mahin Advertising Company. Price, in flexible covers, 50 cents.

Beginning with the earliest form of water craft, this little work comprises the history and development of the small boat, from the peculiar forms devised by savages in all lands and ages, to modern power boats of the latest type. Some of the constructions described are of the crudest and oddest description, and examples are taken from all over the world. The illustrations are pen and ink drawings, and cover with a good deal of completeness the various forms of boats described. Acknowledgment is made at the end to the Truscott Boat Manufacturing Company, for designs of the later type of boats.

Howell's Album of Marine Celebrities. By G. F. Howell. Size 6 by 9 inches. Pages 172. New York, 1906. The American Shipbuilder. Price, bound in flexible leather covering, $3.

This book consists of photographic reproductions and very brief notices of more than two hundred men prominent in the marine field in and around New York, as well as in other parts of the country. Most of the subjects of illustration are still active in their life work, although a few sketches are given covering men who have been prominent in the past, and have either been retired or have gone from our midst. The sketches are printed on one side only of the paper.

Morton Memorial; a history of the Stevens Institute of Technology; edited by Professor F. D. Furman, M. E. Size 8 by 11¼ inches. Pages 641. Numerous illustrations. Hoboken, 1905. Stevens Institute of Technology. Price $10.00.

This is a monumental volume begun by President Morton as a memorial at the twenty-fifth anniversary of the Institute, and completed after his death. It includes not only the history of the Institute, but gives also brief biographies of the trustees, faculty and alumni, and contains a record of the achievements of the Stevens family of engineers. The record of the Stevens family is one of exceeding interest to engineers generally, because of the great inventiveness shown by the various members of the family during the past century or more, and the importance of the interests which they served. It will be remembered that John Stevens operated a steamboat on the Hudson river three years before Fulton's *Clermont* made its appearance, and that the first armored war vessel ever started for the United States Navy was placed under construction by Robert L. Stevens in 1842. The steam railroad was another important item in connection with the engineering developments of John Stevens, in the early part of the 19th century, and a great variety of mechanical devices of all sorts may be traced to the enterprise of this remarkable series of men.

The book is splendidly printed upon an excellent quality of heavy paper, and is bound in leather.

Marine Boilers. By L. E. Bertin. Translated from the French by Leslie S. Robertson. Size 5¾ by 8¾ inches. Pages 658. Figures, over 300. New York, 1906. D. Van Nostrand Company. Price $5.00 net.

This work, which is a second edition, includes a preface by Sir William H. White, and a new chapter on liquid fuel by Engineer-Lieutenant H. C. Anstey, R. N. The subject is gone into with a great deal of thoroughness, and is well illustrated by cuts showing the different types of boilers, and their installation on board ship. A number of folding plates are included in the text, giving opportunity for the use of larger illustrations than would otherwise be the case. In addition to this are a number of plates on coated paper, with half tone illustrations of boilers of special types.

The subject of boilers for naval purposes is given a great deal of consideration, and much of the matter covers water tube boilers of various types. A great deal of detail is given regarding not only boiler construction and fittings, but also accessories, such as feed water regulators; various types of circulators and feed water purifiers; filters; oil extractors; feed water heaters; distillers; and even ash hoists.

At the end are given the reports of the boiler committee of the British Navy, dated from 1900 to 1904.

The subject of liquid fuel is taken up in considerable detail and well illustrated. Various furnace arrangements are shown, together with piping layouts, and details of burners for the use of oil. Calculations are given showing the determination of the size of openings and of the necessary quantity of air to be supplied for best results in combustion. Some attention is paid to mechanical stoking and to forced draft.

In the San Francisco catastrophe, the Main Street Iron Works were totally destroyed, together with all drawings, records, etc. International Marine Engineering is requested to ask manufacturers and others to forward copies of catalogues, and anything else of interest for reference, to the Main Street Iron Works, Alex. de Bretteville, Manager, at the temporary office, 1024 Francisco street, San Francisco, Calif.

QUERIES AND ANSWERS.

All reasonable questions concerning marine engineering received from and signed by subscribers will be answered by the Editor in this column. All communications must bear the name and address of the writer.

Q. 343.—I would like to know the horsepower of a non-condensing engine of the following dimensions: diameter of cylinder, 12 inches; stroke of engine, 24 inches; revolutions per minute, 110; cut-off, two-thirds stroke; boiler pressure, 80 pounds. The engine is double-acting. A. C. R.

A.—The computation of the horsepower of an engine from data as given can never be exact, but it presents very little difficulty if an approximate result only is required. There are some assumptions which will have to be made in this connection before anything can be done, among which are the back pressure on the engine and the amount of clearance in the cylinder. We have assumed that the back pressure is 5 pounds above the atmosphere, and that the clearance may be represented by 10 percent of the piston displacement. We have, in working out the result, neglected the effect of the piston rod in decreasing the available area on the crank side of the piston. We have assumed that the drop in pressure between boiler and engine will be 5 pounds.

The pressure at which the engine takes steam is 75 pounds per square inch, gauge, which would be represented by about 90 pounds absolute. The ratio of expansion is represented by the piston displacement including clearance, divided by the displacement to point of cut-off including clearance, which would be in this case 33/23 or 1.435. The mean pressure of the inlet and expansion line may be obtained from the regular formula $p_m = p_i \times \frac{1+\text{hyp. log. } r}{r}$ but an easier way would be to take it from tables in which these various quantities are used. These tables give the ratio between p_m and p_i as 95 percent. As p_i is 90 pounds absolute, p_m will be 85.5 pounds absolute, and the mean effective pressure will be the difference between this and the 20 pounds absolute represented by the back pressure on the engine. This gives 65.5 pounds.

The length of stroke is 2 feet; area of piston is 113 square inches; and number of strokes per minute is 220. Using these quantities in connection with the mean effective pressure in the formula $\frac{p\ l\ a\ n}{33{,}000}$ the result figures out as about 99 horsepower.

We have assumed the back pressure a little high in order to offset the probable fall in the admission line near point of cut-off.

Q. 344.—Kindly answer the following questions as fully as you can spare space:

1. Does the use of the compressed air in the expander cylinder of an Allen dense air machine operate to increase the thermal efficiency of the machine?
2. Would not the thermal efficiency be as great if the air was expanded directly into the cold air line? Why?
3. Why would not an expander cylinder be desirable on an ammonia or CO_2 machine? C. W. D.

A.—(1 & 2) The power which is stored in the compressed air must, during the coming to a lower pressure, exert itself on something and produce heat there. When the air is expanded slowly in an expander cylinder, the power is taken up outside of the body of air, and produces the heat there. In an air ice machine this power is utilized to help in compressing the air, by linking the expander to the compressor.

When the compressed air is blown out freely through an opening the inherent power is turned first into velocity of motion of the air, and this velocity of motion is at some point stopped by something and turned to heat there in the body of air, and during a continuous process of compression and blowing out refrigerates the air but very slightly.

(3) Theoretically one might figure an advantage by the use of an expander, under certain circumstances, in chemical ice machines, but practically the chemicals used in ice machines are chosen so that they, without the use of an expander, give temperatures as these are practically required, and the use of an expander would be an unnecessary complication. H. B. R.

Q. 346.—In reading over the April number of your magazine I came across two or three words that I do not understand the meaning of, as follows:

(*a*) Page 129, first line at top of second column, "Midship section is 143.54 square feet, corresponding with a coefficient of 0.957." What is the meaning of "coefficient" in this case, and how is it figured out?

(*b*) What is block coefficient?

(*c*) On page 146, the writer gives the d[illegible] the *Adventure*, length, 374 feet; beam, 38 feet 3 inches; molded depth, 23 feet 3 inches; draft, 12 feet 6 inches; displacement, 2,620 tons; coefficient of fineness, 0.51. What is the meaning of "coefficient of fineness," and how is it figured out?

(*d*) Second paragraph, second column, "plate 27 inches wide and 17 pounds thick." What is meant by "17 pounds thick?" J. W. C.

A.—(*a*) This vessel has a beam of 30 feet and draft of 5 feet, hence if the shape of midship section were a rectangle with above dimensions the area would be 150 square feet. The actual area, however, as given above, is less than this, and the coefficient given shows the ratio between the actual area, and the area of the rectangle having dimensions equal to the extreme dimensions of the section. This coefficient thus shows the fining away of the section of the boat around the bilges.

(*b*) The block coefficient is the ratio between the volume of water displaced by a vessel when floating at its normal draft and the volume of a rectangular solid the length, breadth and depth of which are equal respectively to the length, beam and draft of the vessel.

(*c*) The coefficient of fineness of the *Adventure* as given on page 146 is the block coefficient described above. It is found by dividing the displacement of the vessel in cubic feet by the product in cubic feet of the length, beam and draft. The displacement in cubic feet is the displacement in tons multiplied by 35, there being 35 cubic feet in one ton of sea water.

Coefficient of fineness is a general term covering all sorts of coefficients of this character. It might include midship section coefficient, as mentioned above, or cylindrical coefficient, sometimes known as prismatic coefficient, which is the relation between the displacement of the ship and the displacement of a solid of the same length, but of a uniform cross section equal to that of the midship section; or it might mean any one of a number of other coefficients connected with the geometrical properties of the ship. These coefficients were explained in an answer to a Query, published at page 480 of our issue for November, 1905.

(*d*) A plate 17 pounds thick is a plate of such thickness that one square foot of the material would weigh 17 pounds. With wrought iron, a plate of one square foot in area and one inch in thickness weighs 40 pounds, while with steel the weight is 40.8 pounds. The thickness of the plate in question is a little more than 3/8 inch, as a 3/8-inch plate would weigh 15.3 pounds per square foot.

Q. 347.—I notice that some papers speak of the speed of a ship as so many "knots," while others call it "knots per hour"; which is correct? N. S. Y.

A.—The knot is a measure of speed and not of distance, therefore, the speed of a ship should be expressed as being so many knots.

The distance, which is sometimes called a knot, but which is more properly known as a geographical or nautical mile, to distinguish it from the statute mile of 5,280 feet, is the length of a minute of arc on the great circle of a sphere whose area is that of the earth. It is slightly less than one minute of arc on the equator, and has been computed to be 6,080.27 feet. In practice the fraction is omitted, and 6,080 feet is taken as the length of a nautical mile.

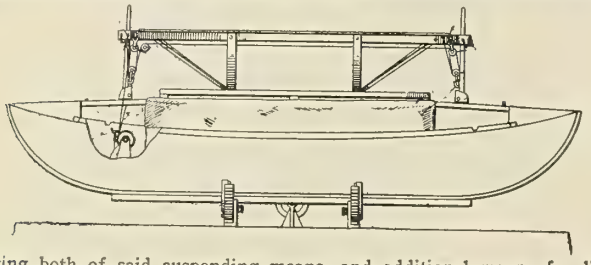
The term "knot" means really "nautical mile per hour," and hence the words "per hour" in the term "knots per hour" are wholly redundant.

SELECTED MARINE PATENTS.

The publication in this column of a patent specification does not necessarily imply editorial commendation.

812,069. ATTACHMENT FOR BOAT-DAVITS. NEIL MURCHISON, NEW YORK.

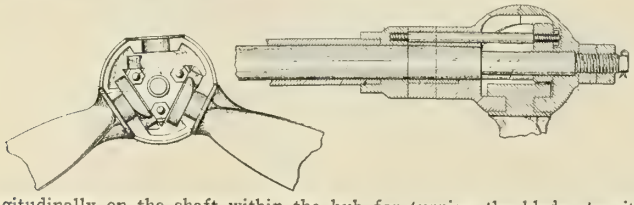
Claim.—3. The combination of a pair of connected davits each having a curved portion to support and overhang a boat, means for suspending one end of the boat from each of said curved portions, means for rocking the davits to swing the boat into and out of them, means for simultaneously



operating both of said suspending means, and additional means for lifting the boat out of the chocks of the davits; said last-named means comprising a lever fulcrumed to the suspending means and connected with the boat. Fifteen claims.

812,475. BOAT-PROPELLER. CHARLES E. BARBER, SYRACUSE, N. Y.

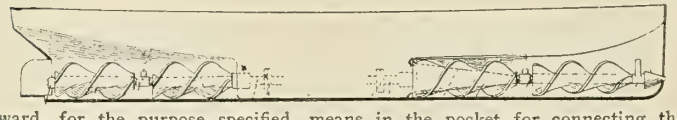
Claim.—1. In a boat-propeller, the combination of a rotary shaft suitably sustained against endwise movement, a propeller-wheel comprising a hollow hub mounted on said shaft and a plurality of radially-disposed blades pivotally and detachably secured to said hub, a block sliding



longitudinally on the shaft within the hub for turning the blades to either propelling or reversing positions, a longitudinally-shiftable sleeve embracing the shaft, means adjustably connecting the block to said sleeve and transmitting motion from the latter to said block, and means for shifting said sleeve. Five claims.

812,604. MARINE VESSEL. JOHN J. SITZLER, NEW YORK.

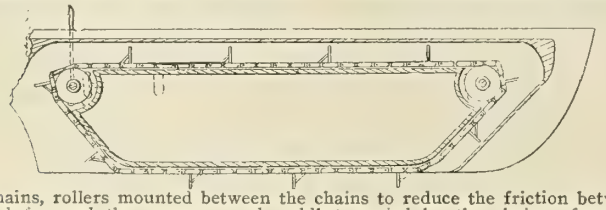
Claim.—1. A marine vessel having a hull with a pocket projecting downward from its bottom below the floor-line of the hull, said pocket being adapted to carry the engine crank-shaft, two propelling-screws projecting fore and aft and extending respectively from the ends of the pocket to the bow and stern, said screws having shafts projecting into the pocket and the shaft of the forward propeller being tapered from the pocket for-



ward, for the purpose specified, means in the pocket for connecting the shafts with the crankshaft, a conical head at the forward end of the forward screw and means for revolubly mounting the screws said means for mounting the screws comprising bearings at the bow and stern and an additional bearing for each shaft located intermediate the pocket and the bow and stern bearings respectively. Two claims.

813,648. ENDLESS PROPELLER FOR BOATS. GEORGE R. HORTON, SAN DIEGO, CAL., ASSIGNOR OF ONE-HALF TO EDGAR L. NICHOLSON, SEATTLE, WASH.

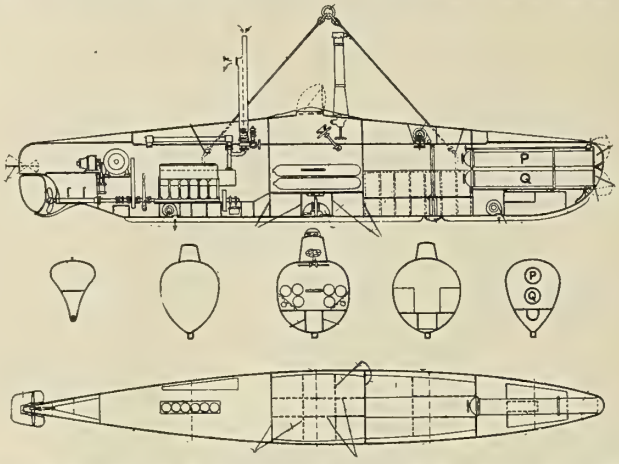
Claim.—1. In combination with a vessel, a raceway, an endless propeller arranged for travel upon the raceway, said propeller embodying a plurality



of chains, rollers mounted between the chains to reduce the friction between the chains and the raceway, and paddles carried by the chains aforesaid. Nine claims.

812,956. SUBMARINE VESSEL AND MECHANISM CONNECTED THEREWITH. GEORGE SIMPSON, MARINER HARBOR, N. Y.

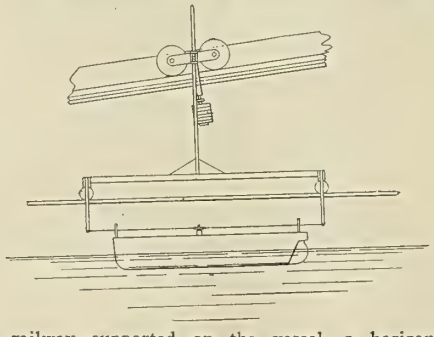
Claim.—2. A submarine having each of the following features; namely, vertical rudder and horizontal rudder, a hull devoid of external steering devices except said rudders and provided with an overhang above a rudder and propeller space, which hull is wider at both ends at the mid-height of said overhang than at the corresponding distance below the



center of gravity and is strengthened internally by transverse partitions and longitudinal partitions in the submerging water-tanks and externally by longitudinal plates forming an open-faced keel, sling-receiving devices of sufficient strength to support the submarine in air attached to said hull at about the level of said mid-height, a projecting spring-held bar between said keel-plates and an internally-located pump with vertical discharge for regulating the position of the submarine relatively to the plane of the horizon. Two claims.

813,413. EXPERIMENTAL TANK FOR TESTING SHIPS' MODELS. JOHN McLAREN FORD, BARROW-IN-FURNESS, ENGLAND.

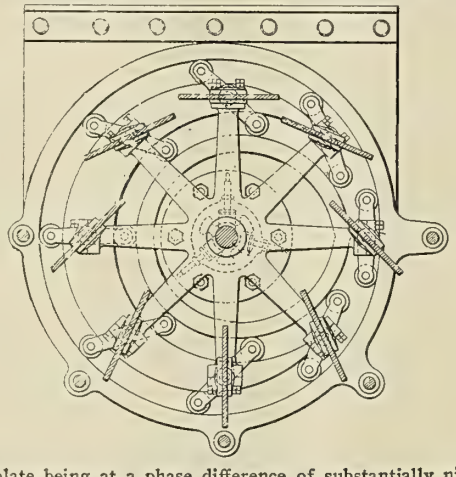
Claim.—3. An experimental tank comprising, in combination, a vessel,



an inclined railway supported on the vessel, a horizontal railway, a weighted trolley adapted to run on the inclined railway, a trolley adapted to run on the horizontal railway and means for connecting the trolleys together and to the model being experimented with. Six claims.

814,495. PADDLE-WHEEL. GUSTAF A. WIMAN, OF MALMO AND FRIDOLF SCHAUMAN, OF STOCKHOLM, SWEDEN.

Claim.—1. In paddle-wheels, stationary end plates, a shaft passing concentrically through said plates, each of said plates having a pair of slots disposed eccentrically around said shaft and so placed one within the other that they intersect at a given point, the intersecting point of the slots



in one end plate being at a phase difference of substantially ninety degrees from the intersecting point of the slots in the other end plate, paddle-boards interposed between said end plates, pivot members rigidly secured to each end of said paddle-boards, supporting-arms for said pivot members carried by said shaft, and rollers carried by said pivot members adapted to travel in said slots whereby the relation of the planes of the paddle-boards to the shaft will be constantly varied during the travel of the boards around said shaft. Two claims.

815,270. PROPULSION OF VESSELS. THADDEUS DAVIDS, LITTLE NECK, N. Y.

Abstract.—The invention consists in a vessel provided with a tube passing through the hull or extending from the bow to the stern of a vessel and with a propeller located directly at the end of the tube. Seven claims.